Service Centre Study

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SUMMARY OF PROPOSAL AND STUDY APPROACH

I. INTRODUCTION

The basic objective of this study of Alberta towns is to define the basic structure of the service centres in terms of economic character and retail-service trade importance, and to measure the interaction between these centres. This information will provide a critical background into the spatial variations of the economy of these towns in Alberta, as a prelude for analyzing influences which will change the system of towns.

This preliminary report concentrates upon the identification of data sources and available research techniques needed to analyze the character of Alberta today. A brief statement on the empirical project to be carried out on each phase of the investigation is provided. No attempt is made in this report to summarize the relevant theory, nor the hypotheses of the expected results. The report is designed to demonstrate whether the suggestions made in the initial contract are feasible.

In general, it is shown that most aspects of the study initially proposed can be carried out. Inaccuracies in the Alberta Bureau of Statistics data on retail-service functions means that an alternative source of data will have to be used. It is not anticipated that any major cost overrun will result. However, to avoid any possibility of financial difficulty it is proposed to split the study into three sections dealing sequentially with: economic character; service centre importance; and interaction analysis. Some restrictions in the scope of the last section may have to take place if the cost of completing the service centre study escalates.

II. ECONOMIC STRUCTURE OF TOWNS

At first sight, it appeared to be impossible to obtain an accurate picture of the economic structure of small Alberta towns. Information on employment by occupation and industry is only published by the federal census authorities every ten years as part of the decennial population review, and is restricted to certain size categories. Thus, the most detailed published data related to 32 categories of occupation is for towns greater than 10,000 population; although finer occupational breakdowns are available for larger centres.

A. Data Sources

Fortunately, the Census Enumeration Area data tape series can be used to measure the economic characteristics of small towns. Several problems exist with this source:

- only eleven categories of occupation are available;
- the latest information is only for 1971; and
- the information is available for enumeration areas, not towns, and sometimes these census collecting areas include some surrounding farms. For centres greater than 600 population this addition of the farm population is quite small - for small places it becomes more of a problem.

B. Techniques

In terms of techniques a wide variety of alternative methods for summarizing economic character have been proposed. However, the most acceptable measures are the Location Quotient, and Gini Coefficient techniques since these make fewer assumptions than other approaches suggested (Marshall, 1975; Pratt, 1978). The first measures the degree of deviation of each category of employment in a centre from some national or provincial average; the second technique provides a summary measurement of the degree of specialization of the centre on a scale from 0.0 to 1.0. Computer programmes using these techniques have been written and tested at Calgary. Data from the Enumeration Area tapes is being extracted.

It is possible to define the economic structure of Alberta towns (600 population) using 1971 enumeration area data available at the University of Calgary. Location Quotient and Gini Coefficient techniques will be used.

The results of the analysis will show:

- The spatial variation in economic character of Alberta towns in 1971, and the degree of specialization of towns in particular categories of employment; and
- the relationship between population size, change and economic character.

III. SERVICE CENTRE IMPORTANCE AND STRUCTURE

Most Regional Planning Commissions in Alberta have attempted to define the importance of towns, as measured by retail and service trades, as part of their review of existing conditions. The assumption is made that an adequate knowledge of the existing service centre patterns and trends forms a vital first stage for any planning exercise. Unfortunately, a review of the studies that have been made in Alberta as well as the available sources of data revealed a number of major problems. These are considered to be of sufficient magnitude to justify a new service centre analysis. Evidence for this view is provided in the following three sections: limitations of existing Alberta studies; data sources available; techniques employed. The review is followed by a synopsis of the study proposal.

A. Limitations of Alberta Service Centre Studies Already Completed

1. Comprehensiveness - Most existing studies, especially of the Regional Planning Commissions, are not comprehensive. Since they only deal with particular parts of the province it is impossible to obtain a province-wide understanding of service centre characteristics.

2. Comparability - The studies are not comparable because of several different types of inconsistency.

a) Time - They have been produced at various times (e.g. Peace River, 1971; Oldman River, 1971; Red Deer, 1976) making it difficult to determine whether differences are due to regional variations, or temporal changes.

b) Data -

(i) Sources - Various data sources have been used, and these sources have shown to provide quite different figures. For example: the Peace River Study (1971, Appendix 2) appears to use Alberta Bureau of Statistics information; the Oldman River Study obtained the data from a personal survey of the area; Davies and Gyuse (1974) used Dunn and Bradstreet data.

(ii) Data Categories - It is vital to differentiate between various categories of retail and service trade, but since the categories used in these sources vary, another source of variation is identified. Hence, it is unlikely that each type of function listed in different sources is placed consistently in a defined category.

(iii) Explicit Data - The studies do not provide the raw data of their studies in an Appendix to the reports - making it impossible to replicate the studies.

c) Techniques - A wide variety of techniques have been used to define hierarchies of centres; the studies by the Regional Planning Commissions being particularly dated in terms of any sophistication of technique. The limitations are best appreciated by a brief summary of some of the studies.

(i) Peace River (1971, p.20). No explicit technique for defining the hierarchy is explained; however, it seems (the word 'seems' must be emphasized) that the 7-fold grouping was derived by analogy from Christaller's 1933 system based on his largest place, Munich. A ridiculous comparison given the fact that Peace River's largest place was only 12,000 at the time of study.

(ii) Oldman River (1970) used the breakpoints proposed by the 1957 Royal Commission in Saskatchewan study to define a 5-fold grouping, e.g. Village level 11-30 functions; Town 31-55 functions, etc. This is a very crude measure since the 'cut off' points seem rather arbitrary, and all functions are weighted equally. Also it is likely that the 13 year time gap has produced many changes in the number of functions at any hierarchical level.

(iii) Red Deer (1976) used a point system based on a variety of different types of functions - including population, and industrial size. The logic of the point derivation and assignment is difficult to follow, and no justification for the allocation of points is provided; furthermore arbitrary cut-offs are used to produce grades of centre.

(iv) Tjorshelm (1972) produced one of the few province-wide studies. His classification of centres is a modification of a technique first used in England in the 1930's (Smailes, 1942; Dickinson, 1956). A set of categories defined by functions are invented and towns are placed in these categories. Obviously the utility of the resulting 'hierarchy' depends on the initial assignment of 'marker' functions as grades. No evidence for the utility of the markers is provided, therefore the results must be criticized.

(v) Davies and Gyuse (1975) applied cluster analysis methods to the town/function matrix to define the groups of places in the Calgary area. It was noted that a variety of alternative similarity measures, and clustering routines were available; consequently, the approach must be treated with care. However, the authors maintained that Ward's method, applied to Euclidean Distance measures, represented the best solution (Ward, 1963) as arbitrary decisions on scaling the data, or predetermining the groups are not made. The biggest limitation, apart from the decision on how many groups to interpret, is that the initial hierarchical assignments are perpetuated at future grouping stages; although, the adoption of the Discriminant Analysis Tests meant that re-assignments could be made. This method appeared to be the most sophisticated technical analysis of retail-service characteristics of Alberta towns. Its restriction to one small area of the province limits its use.

d) Results - Variations in the data and the techniques described above mean that it is fruitless to compare the various studies. Not surprisingly the number of grades of centre vary, for example, from 7 groups in Peace River to 4 (plus a specialized town) in the Calgary area.

B. Data Sources for Retail-Service Centre Studies

An accurate up-to-date and comprehensive data source is the first requirement for a service centre study. Several different sources of data could be used: Alberta Bureau of Statistics Retail-Service data; Dunn and Bradstreet Fact Books; Telephone Directories; Alberta Consumer and Corporate Affairs Business Licensing Records. Federal sources were considered to be less useful since they were too out of date.

During the initial proposal and costing state it was assumed that access to the detailed Alberta Bureau of Statistics (A.B.S.) figures on retail-service functions for each place would provide the necessary data base. The annual published A.B.S. reports only provide a complete breakdown, with 50 different types of functions, for places greater than 5,000. In places with 2,000 - 5,000 population only 10 categories are shown while in smaller centres only the total number of retail and service functions are listed. Moreover, A.B.S. is in the process of revising its files on retail-service businesses, using Alberta Government Telephones data for business phones. Despite their initial optimism of providing the detailed data for mid-July a revised date of November 1978 has been given. This time period meant that an alternative source of data has to be obtained if the study is to be completed on time.

A survey of the four basic data sources (A.B.S., Dunn and Bradstreet, Telephone Directory, Alberta Consumer and Corporate Affairs Licensing Department) was carried out in the Calgary region in order to determine their respective utility and the results were compared to a field survey. Since Dunn and Bradstreet and the Licensing Department records do not incorporate many independent service trades these functions were not added into the comparison. In other words the comparison was only carried out by a reference to a standard set of retail categories. As far as possible the definitions of the retail categories were related to the Canadian Standard Industrial Codes. In all cases the most recent 1978 figures available were used; although, it must be noted that the A.B.S. records are for 1976.

Table S-1 shows that the four data sources vary considerably in the number of retail functions identified in the sample set of 16 centres. In total the Alberta Bureau of Statistics (A.B.S.) and Dunn and Bradstreet records vary the most, with total figures 12% below the field survey results. The Licensing Department records are more than 7% higher. By contrast the Telphone Directory figures are less than 2% different. Individual towns, however, vary drastically with Airdrie ranging from 13 in A.B.S. lists to 32 in the telephone book and Nanton with 38 in A.B.S. records and 24 in the telephone book.

Table S-1

Numbers of Comparable Retail Establishments by Various Sources

			5	4	3	2	1
1.	Centre	Population (1976)	Phone Book (1978)	Field Survey (1978)	Dunn & Brad. T.(1978)	A.B. Statistics (1976)	A.C.C. Affairs (1978)
1.	High River	3598	775	76	72	58	72
	Didsbury	2153	305	29.5	23	30	34.5
	Okotoks	1795	34	35	22	24	27.5
	Cochrane	1450	31	31	24	23	34
5.	Airdrie	1408	32	30	21	13	27.5
	Nanton	1152	24	28	24	38	36.5
	Carstairs	1059	17	20	22	19	20
	Crossfield	777	14	15	11	14	16
	Trochu	752	19	21	21	21	26.5
10.	Beiseker	486	11	12	9	9	12.5
	Acme	351	8	7	10	11	13
	Linden	296	6	5	8	8	13
	Irricana	264	6	6	8	4	8.5
	Blackie	223	4.5	5	2	6	
15.	Swalwell	48	1	1	2		
	Lyalta	-	1	1	1		
Total for 16 Towns			316.5	322.5	280	278	341.5
% Difference from Phone Book Data				+1.9%	-11.5%	-12.2%	+7.9%

Sources: Column 5 is from the latest (1978) Phone Book or Directory for these towns.
Column 4 obtained from independent field survey completed in August, 1978.
Column 3 is from Dunn and Bradstreet's latest Fact Book for Alberta.
Column 2 is from Retail and Service Trade Statistics 1976 (published 1978).
Column 1 is from unpublished information in Licensing Department Alberta Consumer and Corporate Affairs.

A complete review of the reasons for these deviations is under preparation, but it does seem that the telephone directories represent the most useful data source short of a field survey of all the towns in the province.

It is proposed to reject A.B.S. and Dunn and Bradstreet Sources. Instead telephone directories will be used for the basic data collection, 'phoning up towns to obtain functions that may be insufficiently described'. With the necessity to obtain data from the directories this means that the overall costs of the study are likely to be underestimated by some 10%.

C. Techniques

It has already been demonstrated (Davies and Gyuse, 1975) that Cluster Analysis techniques represent the most satisfactory method of defining the various hierarchical grades or groups of towns and identifying the specialized or nonconforming towns. The most sophisticated Cluster Analysis computer package programme (Wishart, 1976) has been implemented at the University of Calgary and has already been tested. Out of the wide variety of alternative cluster procedures it is proposed to adopt the now standard Euclidean Distance-Ward's Hierarchical method approach, then compare the results against non-hierarchical methods and with a final Discriminant Analysis test to ensure that the group finally defined are as accurate as possible.

Cluster analysis techniques will be applied to the data on the functional character of towns obtained from telephone directories. This will enable the investigation to:

- define the hierarchy of towns and their characteristic functions in Alberta;

- define the functions typical of a level missing in particular towns; perhaps leading to the identification of commercial opportunities for local entrepreneurs;

- demonstrate the spatial variations in the commercial importance of places across the province. If time permits this will be related to population density, distance from large towns, and ecological area.

If time permits; standard regression techniques, and Davies' Functional Index Method (1968) will define the threshold level (i.e. order of entry) for each individual function and the commercial deficiencies or surpluses of each centre.

It should be noted that not all towns can be analyzed. It is proposed to cut out the smallest places (probably 5 functions) to reduce the problem to manageable proportions, given the computer core limitations of the cluster analysis programmes and inaccuracy of data source.

Also the hierarchical grades obtained will be compared with those defined by the Regional Planning Commission.

IV. INTERACTION BETWEEN ALBERTA TOWNS

Towns interact with one another in a variety of different ways and it is generally accepted (Dunn, 1970; Pred, 1973) that we only have a limited understanding of the range and structure of these connections. Although it is likely that the structure or pattern of these interaction patterns varies, according to the type of connectivity, it is becoming obvious that these types are not all unique; certain indicators summarize particular sets of interactions. For example, telephone calls are thought to be a useful measure of the interaction normally described as 'community of interest' in which the dependency of each town on other centres for social and business functions is measured. Out of the variety of alternative techniques, that have been used, factor analysis based on a matrix of correlations seems to be the most appropriate measure (Davies and Musson, 1978).

These empirical studies of interactions are complemented by an emerging theoretical literature in which models of interaction are used to define the relationships between towns. These models range from the simple gravity formulation of Reilly (1931) in which interaction is defined for pairs of towns, only one pair at a time, to the sophisticated formulation of Huff (1972) in which the competition between sets of towns is used.

In Alberta the empirical studies of interaction using telephone calls are dated, as in the Alberta Atlas, or are restricted to one small area (Peace River Central Place Survey, 1971). In addition, they are rather deficient in technique since only the largest flows seem to have been mapped (Peace River

1971, p.44), thereby losing much of the complexity of the data set. Moreover, the theoretical model approach has been restricted to the rather outdated Reilly formulation (Alberta Municipal Affairs, 1973; Oldman River, 1972).

Negotiations are currently underway with A.G.T. through the Department of Municipal Affairs to obtain telephone interaction data. Problems still exist over the following points:

- number of towns for which data can be provided;
- dates of phone call data; average daily flows; sample dates;
- types of calls; all calls/sample; business and social or separated;
- flows from Alberta centres to which places outside the province;
- incoming or only outgoing calls; and
- total number of calls generated.

Satisfactory resolution of these problems will enable the following to be completed.

1. It will be possible to analyze the structure of the telephone interaction pattern between Alberta towns using factor analysis techniques to define the pattern of interchange and community of interest areas.

- Note, to avoid a closed system approach the larger towns outside the province will be added to the matrix of interaction.

- As well, higher order factor analysis techniques will define successive levels of interaction. Some of these procedures are available using the Statistical Package for Social Science (S.P.S.S.) programme at the University of Calgary. Other programmes may be available from research workers in the Psychology Department, University of Alberta.

- Also, tests of alternative factor procedures are needed to define the stability of the structure using different techniques.

2. Theoretical 'community of interest' areas will be obtained from Huff's Interaction Model (1972) and compared to the empirical pattern defined in (1) above.

- A computer programme using Huff's model has already been implemented in the University of Calgary Computer System.

- Alternative measures of a town's importance, such as population size, retail-service size, number of telephone calls will be used and the results compared.

REFERENCES

Alberta Dept. of Municipal Affairs (1973), Maps of Trade Areas in Alberta.

Christaller, W. (1933). (Translated by Baskin, C). "Central Places in S. Germany". Prentice Hall 1966 (Translation).

Davies, W.K.D. and Gyuse, T. (1975). Changes in the Central Place System Around Calgary, 1951-1971, in Barr B. (ed), Calgary: Metropolitan Structure and Influence. Western Geographical Series 11, p. 123 - 152.

Davies, W.K.D. and Musson, T. (1978). Changes in the Journey to Work Patterns in South Wales 1951-1971. Regional Studies, forthcoming.

Dickson, R.E. (1956). City, Region and Regionalism. Routledge and Kegan Paul.

Dunn, E.S. (1970). A Flow Network Image of Urban Structures. Urban Studies, 7, p. 239-258.

Huff, D. (1973), The Delimitation of a National System of Planning Regions, Regional Studies, 7, p. 323-329.

Marshall, J.U. (1975). City Size, Economic Diversity and Functional Type: The Canadian Case. Economic Geography, Vol. 51, p. 37-49.

Oldman River Regional Planning Commission (1970), Service Centre Study.

Peace River Regional Planning Commission (1971), Central Place Study.

Pratt, R.T. (1968). An Appraisal of the Minimum Requirements Technique. Economic Geography, 44 p. 117-124.

Pred, A. (1973). Systems of Cities. Lund Studies in Geography, Series B, 38, p. 9-82.

Reilly, W.J. (1931). The Law of Retail Gravitation. N. York.

Red Deer Regional Planning Commission (1976). Service Centre Study.

Royal Commission in Saskatchewan on Agriculture and Rural Life (1957). Service Centres Report No. 12, Regina, Queen's Printer.

Smailes, A.E. (1944). The Urban Hierarchy in England and Wales. Geography,29,p.41-51.

Tjorshelm, G. (1972). Central Places in Alberta. Unpublished M.A. thesis, Dept. of Sociology, University of Calgary.

Ward, J.H. (1963). 'Hierarchical Grouping to Optimize an Objective Function'. Journal of the American Statistical Association, 58,p.236-244.

Wishart (1976). Clustan, C. (A suite of Cluster Analysis Procedures). University of London Computing Centre.

CHAPTER 1

DATA SOURCES ON RETAIL-SERVICE TRADES IN ALBERTA

I. INTRODUCTION

Any service centre study requires accurate, comprehensive, and up-to-date information on the distribution of retail and service activities in the area being studied. At first sight the accurate measurement of the retail and service businesses found in Alberta towns would appear to be a simple task. After all, the investigation is not dealing with unfamiliar or microscopic phenomena requiring specialized equipment to monitor. Everyone in our specialized society is aware of the differentiation of retail and service activities; since they use these outlets to obtain the goods and services they require. But this very familiarity with the content area of the investigation seems to be responsible for the presence of some major problems in both the accuracy and comparability of retail and service data used in service centre studies. The ready availability of the data has meant that individual researchers made their own decisions about the various categories of the retail and service trade. This ensures that the results of one study are not comparable with those of another, making it difficult to obtain precise equivalence between the individual conclusions. Similarly, although several organizations provide information on retail and service trade numbers, different ways of collecting the information have been adopted. This, added to the different time scales involved, ensures that data sources are not comparable. One result is that it is difficult to avoid the conclusion that greater accuracy and comparability may result when less familiar phenomena are investigated. In such situations, the researchers involved usually meet and agree on standards of measurements.

It is the objective of this report to describe the data analysis procedures used to collect data on the distribution of retail-service businesses in Alberta centres. Given the objectives of obtaining an accurate comprehensive, and up-to-date data set, this justification of the information to be used is a necessary preliminary requirement for the analysis. The report is divided into three parts:

- Definitions of Data on Retail-Service Trades;
- Sources and Comparisons of Data Sources;
- Final Decisions on Data Collection.

II. DEFINITIONS OF DATA

Contemporary analyses of service centres rely upon multivariate techniques such as cluster analysis. These methods require the retail-service trade data to be organized in a matrix form. Normally the columns are formed by the individual retail and service categories, and the rows comprise the different centres. By organizing the data set in this way, the two separate problems facing the data analyst are pinpointed; firstly, the identification of the centres; secondly, the identification of the trade and service categories.

A. The Centres

Comparatively few definition problems are found in Alberta since most businesses are found in discrete clusters, or in separate settlements with identifiable limits that are separate from the surrounding countryside. Since the settlements are not always coterminus with the political definition of city, town or village, the study initially concentrated upon the built-up area of the settlement, and included all businesses located in this area, irrespective of whether they were located in the major business centre in the core of the settlement or not. Occasionally some businesses outside the 'built-up area' proper were found; those were added to the retail and service numbers in the nearest settlement or cluster of businesses if they had the same telephone area code and postal address. Small business centres located on their own near a larger centre were separated if they had a distinct address. For example: Pincher Station was far enough away from Pincher Creek and had a distinct address, so it was counted separately. Given the focus of the study upon inter-urban differentiation, no attempt was made to identify the businesses associated with individual shopping centres in the biggest centres; all businesses in the centre were aggregated together. The two major problem areas were found in the Crowsnest Pass and in the Lloydminster area. In the former, several settlements have coalesced to form a small conurbation. The individual centres such as Blairmore, etc. were defined by the settlement name - the municipal limits before amalgamation. In the latter, the Alberta-Saskatchewan border runs through the settlement. A decision was made to add together the two parts on either side of the border to obtain a combined total for Lloydminster.

B. Retail-Service Categories

The second problem is that of obtaining a useful set of categories in order to understand the variety of the retail-service trades found in the Alberta service centres. Davies (1975), in a review of the data and techniques used in service centre studies, showed that most of the early investigators were content to measure the importance of places by means of a simple count of the total number of businesses in retail-service trades, irrespective of the type of business. Others, such as Smailes (1944) used key businesses or indicators to define the various hierarchical groups of centres. Towns were allocated to these groups, even though no attempt was made to justify how the indicators were chosen to index the groups, or even whether a hierarchical pattern of functions and their centres actually existed.

By the 1960's, however, most investigators began to be more comprehensive, in the sense that all of the variety of activities present in any centre were used in the service centre analysis. Inevitably this soon led to problems of what constituted a particular category of retail or service activities since many businesses contained several different types of activity. Strafford (1963) attempted to resolve the problem by distinguishing between three different definitions of activity: establishments - described as the physically separate businesses in a centre; functions - dealt with the total number of activities found in a centre; functional types - measured the total number of different kinds of activity. So for Garage A which sold gas, new cars, and repaired cars, and Garage B, which simply sold gas and new cars, there would be: two establishments (A and B); three functional types (gas, new cars, repairs), and five functions (two gas stations, two new car outlets, one repair shop). Although this approach provided greater detail for any service centre study, it created a new problem: that of identifying the various 'functions' present in any establishment. Moreover, initial definitions of these functions became of critical value, since if a function was not initially defined it was not recorded in the survey. Indeed, in practice, it became difficult to separate these functions without resorting to some kind of sales information about the amount of trade carried out in each of the various categories of business. For example, an investigator would only include functions in a single establishment if these functions accounted for some minimum level - perhaps 25% - of the total turnover.

Recognition of the problems in the establishment, function, functional type approach led Davies (1968) to suggest a more comprehensive approach to the data collection phase of the service centre studies. Table 1-1 shows that information on any business can be organized in 4 scales, or levels of detail, each of which had alternative measurements.

Table 1-1

Stages of Generalization in the Approaches to the Study of Retail Areas

VALUE SOLD	a. _____1.	INDIVIDUAL GOODS e.g. newspapers, journals, cigarettes tobacco, sweets, chocolate, pens, paper, ink, etc.	________b.	
	a. _____2.	ARRAYS OF GOODS (Possibility of several levels of generalization within this stage). e.g. newspapers and journals, stationery, sweet confectionery, tobacco and cigarettes.	________b.	
	a. _____3.	ESTABLISHMENT TYPE e.g. newsagent	________b.	
	a. _____4.	TOTAL ESTABLISHMENTS e.g. all shops	________b.	
	a. ____________	• W	____________b.	CRUDE NO. OF OUTLETS

• W. Possible weights applied to (b.) to arrive at an estimation of (a.) e.g. floor space ratio, assistant ratio, etc.

Source: In W.K.D. Davies - Tijdschrift Voor Econ. En Soc. Geografie - Nov./Dec. 1965 p.65.

Table 1-1 shows the first level is simply the total number of activities, the second is the breakdown by retail trade category, usually recognized by the presence of separate establishments. The third is the level at which distinctive arrays or ranges of goods sold, or services provided, can be defined. For example, since a Drug Store usually sells drugs as well as stationery, magazines, tobacco, and candy, five distinctive functions can be recognized. Beyond this is the fourth level, the individual good level, where one could investigate the variety of different brands or specialisms of particular goods, for example, different brands of pipe tobacco. Carol (1960) showed how larger centres have more goods of any type. In practice, of course, these levels only represent an approximation to the variety of combinations of goods available in the retail trade. Although there are standard combinations of goods, which we recognize as different types of store, it is as well to recognize that combinations vary by town size. In our example, access to the custom of a whole city may allow one retailer to concentrate only upon tobacco sales, since the threshold requirements can be satisfied.

The measurement of these various scales can be carried out in many ways. The crudest is a simple count of the number of outlets, whether individual goods or total shop sales; the most detailed would be the sales turnover figures for these various goods, or total shops. In between, it is possible to use additional information, such as numbers of assistants, or floor space, etc., to adjust the crude numbers of outlet figures so as to arrive at an estimate of sales volume.

Ideally, of course, service centre investigators would like to obtain sales data for the goods level; but, as we shall see, this type of detail is almost impossible to obtain. Most studies are forced to resort to the categories of business and crude number of outlets level. Yet at whatever scale and detail of the data used, this approach still does not resolve a nagging problem for the investigator, namely that of defining a detailed set of categories for the various types of goods or businesses. All too frequently, investigators have 'invented' their own categories, which means that it is almost impossible to compare individual service centre studies.

Today, there is little excuse for perpetuating this individualistic approach since most countries, including Canada, have their Standard Industrial Codes (Statistics Canada, 1970) which comprehensively define the various categories of business by a 3 or 5 digit classification (Table 1-2).

Table 1-2

Examples of Canadian Standard Industrial Codes

3 Digit	5 Digit	Description
		Major Group 2 - Retail Trade
665		Women's Clothing Stores
	667.01	Women's and Misses Clothing Stores
	667.02	Women's and Misses Sportswear Stores
	667.03	Lingerie and Hosiery Stores
	667.04	Millinery Stores
	667.05	Fur Stores
673		Hardware Stores
	673.01	Hardware Stores
	673.02	Paint, Glass and Wallpaper Stores
676		Household and Furniture & Appliance Stores
	676.01	Furniture Stores
	676.02	Household Appliance Stores
	676.03	Furniture, Television, Radio & Appliance Stores

Source: Statistics Canada Publication 12-501 (1970).

Use of the S.I. Codes resolves part of the major definitional problem described above, namely the identification of categories. Although the decision to use the 3 or 5 digit system must still be made by the investigator, it can be noted that the S.I.C. system is sufficiently broad to be used at the establishment or function level, to use Stafford's (1963) terminology, or the establishment/arrays of goods level of Davies (1968). Unless, however, sales information is provided, the final decision in allocating a store into one or other category is very much a subjective decision. Nevertheless, the existence of these S.I.C. categories does provide a common framework for service centre studies.

III. SOURCES AND COMPARISONS OF RETAIL-SERVICE DATA

It is not practical, for reasons of cost and time, to produce a complete field survey of the distribution of retail-service data in Alberta settlements even for a count of numbers of businesses, let alone turnover figures. In the initial planning phases of the investigation it was assumed that Alberta Bureau of Statistics Retail-Service Trade figures would form the data base. However, preliminary comparisons of the figures provided in their annual reports with local knowledge revealed discrepancies in the number of retail-service functions reported for Alberta Centres. Hence, it was thought necessary to carry out a trial investigation to establish the accuracy of available sources.

Not all of the sources provided data on service trades so the comparison was restricted to the Retail sector at the 3 digit S.I.C. level, from 630 (Food Stores) to 699 (Other Retail Stores). Four different sources were scrutinized using the latest data set: Dunn and Bradstreet, Alberta Consumer and Corporate Affairs (Licensing Records), Alberta Bureau of Statistics, and Telephone Directories. The number of retail establishments in these sources were compared with a field survey for 16 towns around Calgary. Since the various sources did not use identical retail category breakdowns it is difficult to obtain exact equivalence between the results, from each source, as the following survey of each data set indicates; therefore, only the total retail trade numbers are compared for the 16 towns. In a subset of 5 of the larger centres the names of businesses were checked, so that the comparison is made in terms of 6 categories of the retail trade as described by Alberta Bureau of Statistics (1978). When an establishment had 2 distinct functions according to the S.I.C., it was allocated half a point in each category, ensuring that the total number of retail establishments remained stable.

Table 1-3 shows the comparison between the figures obtained from each of the 5 data sources for 16 towns. Each of these sources is described in turn and a final evaluation of its utility is made. Before describing each source it is worth noting the conclusion of the study, namely that the telephone directories represent the most accurate and comprehensive data set. Hence, this source was used as the basis of comparison in this discussion.

Table 1-3

Retail Trade Comparisons by Various Sources

			5	4	3	2		1
1.	Centre	Population (1976)	Phone Book (1978)	Field Survey (1978)	Dunn & Brad. T. (1978)	A.B. Statistics (1976)	(1978)	A.C.C. Affairs (1978)
1.	High River	3598	77.5	76	72	58	(195)	72
	Didsbury	2153	30.5	29.5	23	30		34.5
	Okotoks	1795	34	35	22	24		27.5
	Cochrane	1450	31	31	24	23	(47)	34
5.	Airdrie	1408	32	30	21	13	(35)	27.5
	Nanton	1152	24	28	24	38	(50)	36.5
	Carstairs	1059	17	20	22	19		20
	Crossfield	777	14	15	11	14		16
	Trochu	752	19	21	21	21		26.5
10.	Beiseker	486	11	12	9	9		12.5
	Acme	351	8	7	10	11		13
	Linden	296	6	5	8	8		13
	Irricana	264	6	6	8	4		8.5
	Blackie	223	4.5	5	2	6		
15.	Swalwell	48	1	1	2	N.L.		
	Lyalta	-	1	1	1	N.L.		
Totals for 16 Towns			316.5	322.5	280	278	(473)	341.5
% Difference from Phone Book Data				+1.9%	-11.5%	-12.2%	(+49.4%)	+7.9%

Sources: Column 5 is from the latest (1978) Phone Book or Directory for these towns.
Column 4 was obtained from independent field survey completed in August, 1978.
Column 3 is from Dunn and Bradstreet's latest Fact Book for Alberta.
Column 2 is from Alberta Bureau of Statistics Retail and Service Trade Statistics 1976 (Published in 1978). The figures in brackets are from the A.B.S. Preliminary lists of retail trades using A.G.T. Business Telephone Records.
Column 1 is from unpublished information in Licensing Department Alberta Consumer and Corporate Affairs.

A. Dunn and Bradstreet Fact Books

The Dunn and Bradstreet Company is a commercial firm producing directories which rate the credit worthiness of firms and provide lists of businesses by towns and type of activity. As such they have often been used in service centre studies in the Prairies and elsewhere (Stabler and Williams, 1973; Davies and Gyuse, 1975). Since they are published 4 times a year and contain a 4 digit code for each type of business, from industry through retail to services, they appear to provide an up-to-date and comprehensive data source at the establishment level. Unfortunately, the comparison in Table 1-3 shows that compared to the telephone directories they under-estimated the numbers of retail businesses in the sample towns by 11.5%. Many sample towns only showed differences of one or two businesses, but the under-estimation was particularly noticeable for some (but not all) of the more rapidly growing centres around Calgary, such as Didsbury, Okotoks, Cochrane, Airdrie; High River was an exception. It seems the directory entries are not revised with sufficient frequency to identify the rapid changes in small towns. Apart from this problem the source appears to be a reasonable one for most other towns, with the advantage of having numerical codes for businesses. Moreover, a measure of size could be obtained from the source since businesses are grouped into various levels based on annual turnover - although the categories are very broad and seem to be designed for big city businesses rather than those in small towns. Nevertheless, as we shall see the source is not as good as the phone directories, even for the retail trade, while serious questions must be raised about its comprehensiveness for service trades. Spot checks revealed that few of the small, or one-man trade or service businesses, were recorded. This, plus the absence of most of the professional services also detracts from the utility of the source.

B. Alberta Department of Consumer and Corporate Affairs Licensing Records

Most businesses in Alberta have to be licensed by the provincial Department of Consumer and Corporate Affairs (A.D.C.C.A.). Since the license fee varies by the type of business the licensing records would appear to be a very accurate source of data. Scrutiny of the licensing records at the Edmonton Head Office in July 1978 revealed several problems for service centre analysis.

In the first place not all businesses require a license. Most of the retail trades are included, as are many service trades, but professional and financial services, such as banks, doctors and real estate are not licensed; therefore, for the purposes of the study, the licensing records only represent a partial data source. For the retail trade alone, where there is comparability, the sample 16 towns showed a higher number of businesses (+7.9%) than were obtained from the phone directories. Most of this discrepancy was associated with towns such as Nanton and Trochu, places which appear to have lost a number of businesses in recent years, although some of the growing towns around Calgary were again underestimated. Since there is no statutory requirements to inform A.D.C.C.A. on the closure of a business, it is quite possible that the Department will over-record numbers of retail outlets. The Department is changing to a two year licensing system; this problem means that the source will get worse rather than better for service centre studies.

It may also be noted that over-recording may have been a function of the area chosen for analysis. Conversations with A.D.C.C.A. officials revealed that the licensing of businesses is influenced by the manpower available at various branch offices. In the past some towns may not have been visited, and hence, businesses not licensed, for over a year. In other words, it is difficult to use the licensing records to arrive at a precise count of even retail businesses for one precise point in time, the usual method of reporting a census or survey.

A second major problem relates to the categories of businesses used. Excluding the industrial and wholesale categories, some 68 different types of business (excluding separate highway types) are distinguished, but these were not compatible with basic Canadian Standard Industrial Codes. In some cases very detailed categories, at a goods level, were found, such as Dealers in Fireworks (R400). But for others, Dealers in Appliances and Furniture (R330) and Clothes Stores (R335), the breakdown was much coarser than the 3 digit S.I. Code. Also, the categories are not always mutually exclusive, such as R802 (Garage and Dealer in Junk) as well as R120 (Garage) and R210 (Junk). However, in one respect the source does have an advantage, since any business has to have separate licenses for each function carried out on the premises that merits a separate description in the 68 categories. For example, a rural general store with a gas pump and small restaurant would have to have licenses for all three activities. The source could, therefore, be used to obtain 'functions' rather than 'establishments' if only a more systematic set of retail categories were used.

The conclusion must be that the data is useful as a check for figures derived from other sources, but should not be used alone since the categories of the retail trade are not really comprehensive.

C. Alberta Bureau of Statistics: Retail and Service Trade Statistics

Annual reports on the numbers and types of business and turnover figures for Alberta towns hold out the promise that this source is the best data set available for service centre analysis. Although the categories of business and service are based on the Standard Industrial Code, they are over twelve months out of date by the time they are available, since the 1976 figures were published in February 1978. Such a time lag is actually rather reasonable compared to federal sources. A more important limitation is the fact that a complete retail-service breakdown is only available for the clusters greater than 5,000 in Alberta. In centres with 2 - 5,000 population only 10 rather general categories are shown, and for smaller centres only the numbers and sales for total retail and total service trades are published because of confidentiality problems.

Contacts with A.B.S. officials revealed that numbers (not sales) of activities for each of the S.I. Codes could be made available, thereby solving one of the problems of the published figures. Further checks on the accuracy of the information revealed serious flaws in the A.B.S. data that cast doubt upon its accuracy. The comparison shown in Table 1-3 is based only on the retail trade, given the limitations of the other sources. However, the A.B.S. figures show a 12.2% difference in the total number of retail outlets for the 16 towns. These differences vary from town to town, often drastically. For example, 19 establishments fewer than the 76 and 77 recorded for High River by field survey and phone book survey respectively, and 10 and 14 higher for the field survey and phone book survey in Nanton.

These and other discrepancies are hard to explain. Certainly some of the differences may be attributed to the date of the A.B.S. figures, i.e. 1976, but their size suggests that other influences are at work, and it is difficult to avoid the conclusion that the A.B.S. figures are simply inaccurate. Conversations with A.B.S. officials revealed that these lists of the 1976 businesses were based on data provided by the Alberta Department of Consumer and Corporate Affairs. Given the time lag in the licensing of businesses, and the fact that licensing officers may not visit individual centres to check their records for over a year, it is quite possible that the 1976 lists are another two years out of date.

Fortunately A.B.S. officials contacted in August 1978 about these problems were aware of the limitations of their existing data sources. They are currently investigating a new method for obtaining information on retail-service trade numbers by a special 'print-out' of all business telephones provided by Alberta Government Telephones. The complete 1978 figures from this source would not be available until at least the end of 1978 since the records had to be S.I. coded, meaning that it was not possible to use their revised listings for this analysis. At first sight this source should be very comparable with the published directories. However, some criticism of the utility of the business telephone records can be made. The first is that the use of Business Telephone records assumes that all businesses pay the higher business telephone rates, an assumption that could cause problems in the accuracy of the count of smaller businesses. Moreover, A.B.S. officials have found cases where accountants, or head offices, pay the bills for businesses, ensuring that the location of the accountants is listed, thereby detracting from the usefulness of the new A.B.S. source. In Table 1-4 a comparison between the new preliminary A.B.S. listings for 3 towns and other sources is shown. The discrepancy is again high, with a +27.8% difference from the directories. Detailed checks of names in both sources for two towns, Cochrane and Airdrie, showed that half of the error was due to the double listing of businesses in the A.B.S. Business Telephone lists. However, there were also some very disturbing discrepancies in the numbers for the 6 retail categories - in particular in the automotive trades where far higher numbers were recorded. Some of the difference was found to be due to 'out-of-town' businesses, but miscoding of businesses and the failure to record others were also found. The conclusion was that the A.G.T. Business Registrar was not a

Table 1-4

Retail Trade Comparisons: Telephone Directories and Business Telephone Listings

Town (Population)	Cochrane (1450)			Airdrie (1408)			High River (3598)	
ategories	Phone Book	A.B.S.* Raw	A.B.S.* (revised)	Phone Book	A.B.S.* Raw	A.B.S.* (revised)	Phone Book	A.B.S.* Raw
Food	6	6	(5)	5	8	(7)	10.5	(17)
2. General Merchandise	1	4	(3)	0	1	(1)	3	(4)
3. Automotive	7.5	16	(13)	8	16	(15)	19	(26)
Apparel/ Accessories	3	7	(5)	5.5	6	(6)	6.5	(16)
Hardware/Home Furnishings	2	1	(1)	2	1	(1)	9	(20)
Other Retail	11.5	13	(13)	9.5	3	(3)	29.5	(22)
	31	47	(40)	30	35	(32)	77.5	(105)

A.B.S. Information provided by Alberta Bureau of Statistics from Business Telephone lists. Raw figures are obtained by counting all retail businesses listed. Revised means that double counting is eradicated.

useful source of data, since better descriptions were found in the telephone directories.

D. Telephone Directories

Comparison of the commercial information found in the telephone directories with other sources revealed that the directories represented the single most comprehensive set of data at the establishment scale on retail-service activity. This is not surprising since it is difficult to consider that a business can be operated in North America without a telephone. A major advantage is that the directories are revised twice a year and are published quite rapidly, ensuring that the lists are really up-to-date. Obviously, bankrupt businesses cannot be recorded until a directory is revised, but this error is well under 1%. However, the comparison of the phone book data for each town (not yellow pages data) with a follow-up field survey must not disguise the fact that there are many problems associated with their use in service centre studies.

The most obvious difficulty of the telephone directory is that of accurately classifying the businesses. Not all of the original business classifications used could be adapted. For example, General Stores and Grocery Stores were interchangeable titles, while Gas Station and Car Repairs were rarely accurately described. So the establishment types had to be amalgamated. In most cases the phone book description could be related to the business types modified from the 3 digit S.I.Code, but incomplete descriptions were found in 20% of the entries in some cases. These functions were identified by either phoning the establishment concerned, or checking with Dunn and Bradstreet lists of the local Town or Chamber of Commerce. It was discovered that most of the unclassified businesses were industrial, wholesale or holding companies so by removing these types a more accurate categorization of the retail-service trades was obtained. Double city listings, where a single business appears twice, were common and were eradicated. Where two functions were listed for a business, half a point was allocated to each one to make sure establishment numbers were not over-inflated. Unfortunately, there seemed to be no way of identifying or solving the problem of periodic (or seasonal) functions. Where part-time businesses occurred, that is where an outlet operates in two or more places, the establishment was split into half or thirds and allocated to the places mentioned.

The question of the precise location of a business also caused problems. Some of the businesses listed in the directory pages devoted to Town A were actually located in Town B. This over-counting was eradicated insuring businesses with local phone numbers were used. A greater problem relating to the comparison with the field survey concerned the businesses, especially business trades located outside the commercial centre of towns. Frequently some were outside the municipal limits, the built-up settlement, or even functional definition of a service centre. This locational difficulty was resolved by adding the function if the phone number had a local code. Where there were conurbations, or continuously built up areas, such as the Crowsnest Pass, the establishments were allocated to the named community, Blairmore, etc. Where communities are split, such as by the Alberta-Saskatchewan border in Lloydminster, a total figure for both areas was obtained. Apart from the problems already noted the definition of establishment did not cause difficulties, but functions were counted separately, if there was a separate phone listing. In other words, an activity such as 'car leasing' would only be counted as separate from a 'car repair (garage)' function if it had a distinctive phone number, even if the same owner was involved. The premise here is that there has to be enough business to justify the separate listing. In the strictest terms this does breach the 'establishment scale' level of enquiry but checks showed that it was almost impossible to eradicate these double entries, short of checking each pair of phone numbers. This was not practical given the time constraints and the relatively small number of examples identified.

Finally, it was observed that the telephone books were not very accurate for the smallest centres of all. Isolated general stores or gas stations were not always found in the directories; therefore, it was concluded that the smallest places of all, with under 3 or 4 establishments, were probably poorly represented by this source. Results would be interpreted accordingly.

E. Field Survey

In theory this should be the most accurate source of information of all. The only major difficulty would appear to be in the initial categorization of businesses, but the use of the S.I.C. lists followed by modification 'in the field' solves the problem. In practice, however, the field survey produced many problems, with up to 10% errors in the first counts of retail-service activities for the sample towns. Part of the problem related to the fact that many businesses with separate owners were organized from the same buildings, and many service trades were operated from private houses. In addition businesses outside the main commercial area were easily missed, unless each street or even areas within a couple of miles of the town, were carefully surveyed. All these problems were resolved when an initial source of data, the phone directories, were used as the basis for the second field survey of the centres, which then became a check on the accuracy of the directories. In this way, the new businesses, or those that were closed, could be added to the directory information and detailed field checks of the type of business being operated could be made. As a result there were some minor differences from the phone directories, but overall Table 1-3 shows that the agreement with the field survey (+1.0%) was very good. Since it is possible that the comparability of numbers may be due to the 'cancelling out' of errors in the different retail categories a comparison of retail categories for 5 towns was also carried out. The results shown in Table 1-5 demonstrate that the telephone directories and field survey produced virtually identical figures, the single figure differences are primarily due to businesses located outside the town that were missed in the field survey, or new businesses. Although the field survey could be used to produce a much finer scale of analysis than the establishment level, such as the different arrays of goods or functions in each business, this was not attempted in the study since comparability over the whole province represented the final objective of the study.

Table 1-5

Retail Trade Comparisons: Telephone Directories and Field Survey

Town 1976 Population	Cochrane 1450	High River 3598	Airdrie 1408	Didsbury 2153	Crossfield 777
Retail Categories					
1. Food	6(6)	10.5(9.5)	5(5)	6(6)	2(2)
2. General Merchandise	1(1)	3 (3)	0(0)	1(0)	0(0)
3. Automotive	7.5(6)	19(20)	8(8)	7(7)	7(8)
4. Apparel & Accessories	3(3)	6.5(6)	5.5(5.5)	4(3)	1(1)
5. Hardware/Home Furnishings	2(3)	9(8)	3(2)	4(4)	2(3)
6. Other Retail Stores	11.5(12)	29.5(29.5)	10.5(9.5)	8.5(8.5)	2(1)
Total Retail	31(31)	77.5(76)	32(30)	30.5(29.5)	14(15)

Numbers represent count obtained from latest phone directories. The values in single brackets represent figures obtained from field survey (August 1978).

IV . FINAL DECISIONS ON DATA COLLECTION

The evidence in the previous section revealed that Telephone Directories provided the most accurate, comprehensive and up-to-date information source available in Alberta for identifying the number of retail business in the province for all but the smallest places, short of carrying out an expensive field survey - and even the latter did not necessarily produce better results. Since spot checks revealed that the same source was the most reliable for service trades, professions and financial services, the decision was made to use the latest (1978) Telephone Directories for each part of the province to establish the number and variety of retail-service functions for each centre. Given compilation time these probably represented a 1977 business count.

A. Categories

The variety of retail-service activities was obtained by using 83 separate categories of business. These categories were based on the 3 digit Standard Industrial Codes and are listed in Table 1-6. They can be organized in 3 broad types of business:

- Retail
- Service Trades
- Financial/Professional Services

Complete identification with the S.I.C. could not be maintained, since in these largely rural areas of Alberta businesses overlapped the categories and some of the types had to be combined. Totals for unclassified and miscellaneous businesses were included, so that all establishments were counted. The categories of business and the total number of businesses in these categories in Alberta is shown in Table 1-6.

B. Numbers

All places mentioned in the telephone books were recorded initially, but the probable inaccuracy of the directories for the smallest places of all was not noted. Hence, the decision was taken to only include those settlements or clusters of businesses with 3 or more establishments in the data set. In the final analysis, 406 places were identified and Appendix 1 provides, in matrix form, the complete count of 83 businesses by the 406 places. It is

Table 1-6

Number and Type of Retail, Service, Professional Establishments in Alberta

Variable Number Code	3 Digit S.I.C.	Establishment Type	TOTALS FOR PROVINCE Excluding Calgary & Edmonton	TOTALS FOR PROVINCE Including Calgary & Edmonton
RETAIL				
1	631	Bakery and Bread Products	132	265
2	631	Confectionary and Candy	136	201
4	631	Grocery (Inc. Dairy Products)	367	1082
5	631	Meat and Frozen Foods	159	344
6	632	Supermarket	246	351
7	631	Health Foods, Specialty Foods	64	134
8	654	Gas Station, Towing	838	1968
9	658	Auto Body, Repairs	401	1541
10	656	Car Sales, Truck Sales	361	761
11	652	Tires, Auto Parts	415	1140
12	654	Car Wash	48	53
13	894	Car Rentals, Truck Rentals	100	360
14	665	Men's Clothing	128	328
15	667	Women's Clothing	159	469
16	669	General Clothing	256	406
17	676	Furniture	180	385
18	676	Appliances	438	1223
19	676	Carpets, Floor Coverings	108	413
20	676	Curtains, Fabrics	132	317
21	673	Hardware	339	499
22	699	Garden Centre, Nursery	117	217
23	681	Drug Store	280	600
24	696	Liquor and Beer Store	129	174
25	694	Jewellery/Repair	130	355
26	691	Books/Stationery	74	184
27	692	Flowers	133	353
28	699	Craft	133	278

Table 1-6

Number and Type of Retail, Service, Professional Establishments in Alberta

Variable Number Code	3 Digit S.I.C.	Establishment Type	TOTALS FOR PROVINCE Excluding Calgary & Edmonton	TOTALS FOR PROVINCE Including Calgary & Edmonton
29	699	Novelty, Gift, Souvenir	136	416
30	699	Sports	192	437
31	699	Music	72	287
32	642	Catalogue Sales Outlet	128	150
33	663	Shoes	100	280
34	699	Mobile Home	197	327
36	699	Second Hand	46	161
37	699	Motor Cycle	34	154
39	699	Luggage/Leather Goods	40	150
40	699	Photo Studio/Supplier	114	514
42	699	Other Retail (Inc. Pets/ Antiques/Soft Drinks)	92	337
43	642	General Store	455	455
44	642	Department Store (Large)	158	213
45	626	Lumber, Building Supplies	492	702
46	608	Bulk Fuel, (Inc. Propane) and Feed	796	881
47	895	Farm Equipment/Rentals	468	848
48	895	Office Equipment	98	413
SERVICE AND TRADES				
50	841	Cinema	78	143
51	843	Bowling and Billiards	90	175
52	897	Electrical Repair Shop	34	119
54	872	Barber	133	423
55	872	Beauty Salon	413	973
56	874	Laundry/Dry Cleaning (Inc. Self-Services)	158	490
58	877	Funeral Home	79	101
59	881	Hotel/Motel	863	1083

Table 1-6

Number and Type of Retail, Service, Professional Establishments in Alberta

Variable Number Code	3 Digit S.I.C.	Establishment Type	TOTALS FOR PROVINCE Excluding Calgary & Edmonton	Including Calgary & Edmonton
60	886	Restaurant	810	2070
78	897	Upholster	79	254
79	886	Caterer	38	308
80	896	Welding & Blacksmith	442	777
81	421	Plumbing/Heating	613	1108
82	421	Electrical Contracting	318	788
83	897	Miscellaneous Repair Estabs. (Inc. Shoe Repair)	150	400
84	421	Concrete (Ready Mix)	128	168
85	404	Builder	381	1241
86	421	Excavating	288	648
87	421	Painter/Decorator	219	789
89	737	Developer	53	308
90	421	Water Well Drilling	96	171
91	421	Carpenter	53	253
93	404	General Construction	1305	4155
94	898	General Cleaning	157	797
95	421	Sand and Gravel	76	146
96	507	Trucking	989	2249
98		Unclassified Services (Specific Type Not Known)	932	3257
FINANCIAL/PROFESSIONAL				
61	699	Auctioneer	121	176
62	701	Bank	376	776
63	701	Credit Union	148	268
64	866	Lawyers Office	322	1777
65	735	Insurance	554	1404
66	735	Real Estate	473	1843
67	861	Accountant/Income Tax	334	1029

Table 1-6

Number and Type of Retail, Service, Professional Establishments in Alberta

Variable Number Code	3 Digit S.I.C.	Establishment Type	TOTALS FOR PROVINCE Excluding Calgary & Edmonton	TOTALS FOR PROVINCE Including Calgary & Edmonton
68	863	Architect	45	195
69	703	Mortgage and Loan	60	710
70	707	Investment/Holdings	129	359
71	849	Travel Agent	115	395
72	825	Dentist	203	733
73	826	Vet	142	322
74	824	Optometrist/Optician	186	456
75	824	Chiropractor	131	311
76	823	Doctor	694	2254
77	867	Management Consultant	136	471

worth noting that those establishments located in places with fewer than 3 businesses were added to the total number shown in Table 1-6.

This data matrix provides the basic information to be used in the service centre analysis. Errors in the A.B.S. information mean the study cannot incorporate information on turnover.

V . CONCLUSIONS

It is obviously frustrating to find that several very different sources of retail trade statistics provided such variations in even the simple account of businesses, let alone numbers in various retail categories. Despite the time and effort expended by the two government (A.B.S. and A.D.C.C.A.) departments and one crown corporation (A.G.T.) in listing businesses, accurate comprehensive figures are not easily available.

It is recommended that the Department of Municipal Affairs initiate a register of business activities to be kept for all settlements in Alberta. This register should be updated every 2 or 3 years at a precise time, for example June 1. Businesses should be recorded by Standard Industrial Code. The initial register could be compiled from the telephone directories and supplemented by field survey. It would replace the existing files kept by Alberta Bureau of Statistics and Consumer and Corporate Affairs which might be useful for their own purposes, but seem of limited use to anybody wishing to monitor changes in the retail-service trade. Since A.B.S. and Consumer and Corporate Affairs officials already spend time licensing or surveying businesses the new costs involved should be minimal; a re-direction of effort and cooperation is all that should be needed.

The comparison of results in this study has concentrated upon a sample of small towns around Calgary. Attempts will be made to extend this comparison by using the provincial totals for each category of business as calculated by the various data sources.

REFERENCES

Alberta Bureau of Statistics (1978), Retail and Service Trade Statistics 1976, Edmonton, 1978.

H. Carol (1960), 'The Hierarchy of Central Functions Within the City', Annals Assoc. American Geographers, No. 50, p.419-438.

W.K.D. Davies, 'Some Considerations of Scale in Central Place Analysis', Tijdscrift v. Econ. en Soc. Geografie, November 1965, p.221-227.

H.L. Stafford (1963), The Functional Bases of Small Towns', Economic Geography, Vol. 39 (2), p.164-175.

A. Smailes, 1944. 'The Urban Hierarchy in England and Wales'. Geography, 29, p.41-51.

Statistics Canada (1970), 'Canadian Standard Industrial Classification'. Publication 12-501.

CHAPTER 2

AN ANALYSIS OF 1977 TELEPHONE CALL FLOWS AND THE DEFINITION OF THEORETICAL TRADE AREAS

I . INTRODUCTION

A vital part of the geographical characteristics of the pattern of service centres in any area consists of the functional connections or flows between these centres. Flows of people, goods, and information are essential lubricants to the workings of these service centres. Urban centres dispense the goods, services and information to their surrounding areas, and collect similar functions for transmission to larger centres and the rest of the world. In an increasingly specialized age, with greater and greater communication possibilities, inter-urban flows become ever more vital elements in the differentiation of towns and regions.

Obviously a multitude of many different types of flow patterns can be identified in any area, ranging from the migration of people (either permanently, or temporarily through 'journey to work' or 'journey to shop' or 'service' movements) to flows of different types of goods or even information or surrogates of people movements such as numbers of airline trips or bus movements. At present we have little understanding of the differences in the spatial impact of these various flow measures. It is possible that many of these movements of flows have very individual spatial patterns; groups of others may have very similar flow patterns (Davies and Thompson, 1977). Ideally, a complete understanding of the patterns of connectivity between service centres or towns take all the flows into account but only rarely has this been attempted, in part because there is insufficient information on the range of alternative flows organized on a point to point or town to town basis.

In this study only telephone call data will be analyzed. Despite the restriction of the study to one type of connectivity between towns it can be argued that the pattern of telephone calls represents one of the single most useful measures of interaction between towns. Not only do 'phone calls fulfill a variety of administrative, commercial and social functions in the exchange of information but these calls are accessible to practically all the population and are very inexpensive. So it is not surprising that investigators from the time of Christaller (1932) onwards have used telephone calls as their measure of connectivity. Indeed these flows have been viewed as representing one of the best clues of the interrelationships between service centres and to the definition of the trade areas of towns. Although the utility of telephone call traffic in analyzing inter-urban connections is accepted as a fundamental premise in the study, the fact that telephone calls represent only one form of interaction between centres must be emphasized. Hence the results of this study should be interpreted in this context and not taken to imply that this pattern applies to all flows.

In other words, although it can be suggested that telephone calls represent the most useful single measure of inter-urban connectivity, in the last resort it must be accepted that this is only one of the available measures - at least in theory. In practice, we have very little alternative point to point information, apart from migration and journey to work statistics, or transportation flows by road, rail or air. Yet even these statistics on flows are either only readily available for perhaps the largest fifteen places, or represent flow volumes along major routes, rather than true point to point information. Given the respective size of Alberta centres, in particular the population imbalance produced by two metropolitan centres containing over half the provincial population, any study of the volume of interaction flows or movement is bound to be dominated by the Calgary-Edmonton interchange. These flows may be of vital significance but they attract attention away from the relationships existing among the smaller Alberta centres. This is, after all, the primary focus of this research project.

The study reported here falls into four parts:

- the first section summarizes the problems associated with the data source on telephone calls used in the analysis;
- the second section describes the techniques used to describe the patterns;
- the third section analyses the empirical patterns of connectivity found between Alberta centres using a cartographic analysis of the pattern of calls as well as a factor analysis of the data set to summarize the basic interaction patterns; and
- the fourth section defines the theoretical trade areas of Alberta using Huff's multi-centre gravity model (1972) and compares these results with previously calculated trade areas and the empirical patterns produced by the pattern of telephone calls.

II. DATA SOURCES

The data used in the analysis consisted of the total interchange or volume of telephone calls between one hundred and two pairs of places in Alberta during the month of May 1977, together with the calls from these places to nine large centres outside Alberta (Table 2-1). Thus information was specially obtained by the Department of Municipal Affairs from Alberta Government Telephones for this study.

The month of May was chosen as the sample period because it was considered to be a month that was free from seasonal distortions and was, therefore, representative of annual telephone calls. This opinion was confirmed by Alberta Government Telephone officials.

The choice of nine centres outside Alberta was determined primarily by size and location. Hence these places either represented higher order places in the Canadian urban systems, such as Vancouver, Montreal, Winnipeg and Toronto (Simmons 1976), or were the major service centres outside the provincial boundary, such as Dawson Creek (B.C.), Cranbrook (B.C.) or Great Falls (Montana), or larger Prairie regional service centres such as Saskatoon and Regina (Sask.). Although the use of flows from Alberta to neighbouring, or higher order systems does mean that the study dealt with extra-provincial connections, the adoption of this 'open-system' approach has many benefits. The most obvious is that the structure of Alberta flows can be related to the national urban system, while the addition of centres just outside the provincial boundaries ensures that flow patterns near these frontiers are not truncated or distorted because of artificial boundary constraints - a problem of Nystuen and Dacey's graph theory analysis of the State of Washington (1961).

Within Alberta the centres chosen for analysis consisted of the fifty-two centres in the top four grades of the urban hierarchy (Chapter 4) and an additional fifty places comprising the majority of the fifth and sixth grade places. The fact that the fifth and sixth grade places have a mean population value of 1688 and 874 respectively illustrates that an approximate population of 750 limit was used to define the lower population limit of places to be used in the connectivity analysis. However, the fact that this was only an approximate 'cut off' level must be emphasized. The more important limitation in the

Table 2-1

List of Centres in Telephone Call Analysis

ORIGINS

1. Athabasca
2. Banff
3. Barons
4. Barrhead
5. Bashaw
6. Bassano
7. Bentley
8. Beaverlodge
9. Blairmore
10. Bonnyville
11. Bow Island
12. Boyle
13. Brooks
14. Calgary
15. Camrose
16. Cardston
17. Castor
18. Claresholm
19. Coaldale
20. Cochrane
21. Consort
22. Coronation
23. Crossfield
24. Didsbury
25. Drumheller
26. Drayton Valley
27. Edson
28. Edmonton
29. Fairview
30. Falher
31. Foremost
32. Fox Creek
33. Forestburg
34. Ft. Saskatchewan
35. Ft. Macleod
36. Ft. McMurray
37. Ft. Vermilion
38. Grand Centre
39. Grande Prairie
40. Grand Cache
41. Grimshaw
42. Hanna
43. Hardisty
44. High Prairie
45. High River
46. High Level
47. Hinton
48. Innisfail
49. Jasper
50. Killam
51. Lac La Biche
52. Lacombe
53. Lamont
54. Leduc
55. Lethbridge
56. Lake Louise
57. Lloydminster
58. Magrath
59. Manning
60. McLennan
61. Medicine Hat
62. Milk River
63. Morinville
64. Myrnam
65. Mayerthorpe
66. Nanton
67. Niton Junction
68. Olds
69. Oyen
70. Pincher Creek
71. Picture Butte
72. Peace River
73. Ponoka
74. Provost
75. Raymond
76. Red Deer
77. Redwater
78. Rimbey
79. Rocky Mtn. House
80. Sedgewick
81. Slave Lake
82. Smoky Lake
83. Spirit River
84. St. Paul
85. Stettler
86. Strathmore
87. Swan Hills
88. Taber
89. Three Hills
90. Turner Valley
91. Two Hills
92. Valleyview
93. Vauxhall
94. Vegreville
95. Vermilion
96. Viking
97. Vulcan
98. Westlock
99. Wetaskiwin
100. Whitecourt
101. Wainwright
102. Youngstown

DESTINATIONS

1. Cranbrook
2. Dawson Creek
3. Great Falls
4. Montreal
5. Toronto
6. Regina
7. Saskatoon
8. Vancouver
9. Winnipeg

choice of places for which telephone calling data was to be obtained came from the presence of Extended Area Dialling (E.A.D.) in Alberta. Figure 2-1 shows the current map of E.A.D. routes in which several settlements are linked together to form a common dialling and charging system. For example, Banff, Canmore and Exshaw form one toll centre area. The result is that it is impossible to obtain data on the calls from Banff to either Canmore or Exshaw or any alternative pair in this set, although calls from Banff or Canmore to other places in Alberta can be identified. Figure 2-1 shows that this system of extended area dialling is particularly important around the two metropolitan areas of Calgary and Edmonton, as well as in the zone between Edmonton and Calgary. Hence the volume of calls between adjoining places in these E.A.D. zones could not be obtained directly for May 1977. Also some of the larger places peripheral to major centres, such as Airdrie and Carstairs, could not be used in the analysis if neighbouring centres such as Crossfield or Didsbury were incorporated, since too many flow linkages were missing. Similar constraints applied to centres such as Sundre, Bowden and Trochu; on population or functional size grounds, they would be part of the analysis. Where only one call link was missing for May 1977, as in the Beaverlodge-Grande Prairie connection, sample estimates of the flows for previous years were obtained from A.G.T. and adjusted upwards by provincial growth rates to arrive at monthly volumes for 1977. In all only nine such estimated flows out of the 102 x 111 matrix were added to the analysis. In all these cases the missing link was obviously the dominant connection between the town, so that even if the calculated figure was an under or over estimate, only the size rather than the direction of the volume was affected.

III. TECHNIQUES OF ANALYSIS

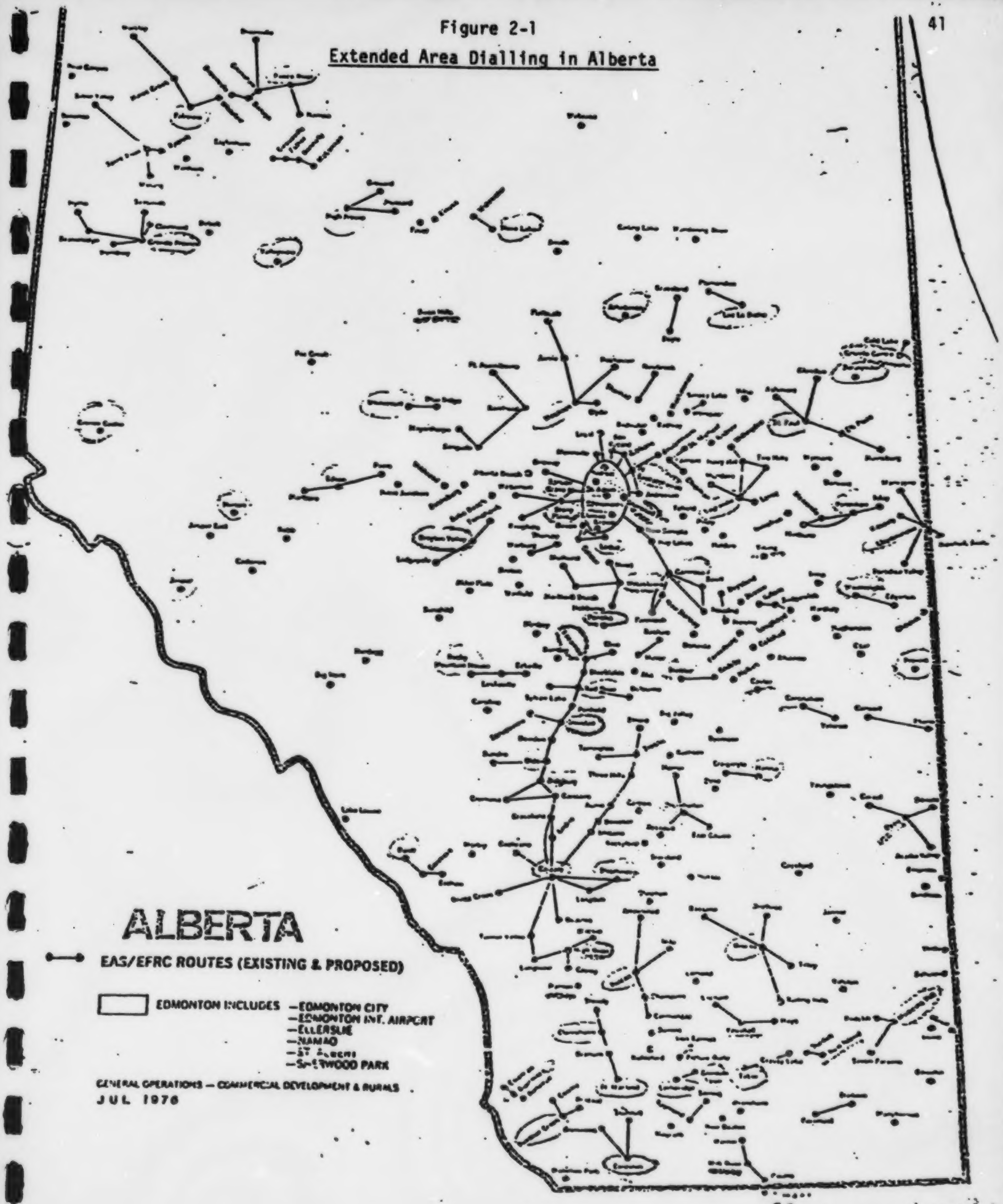
Two very different ways of portraying the structure of the pattern of connectivity in the 102 x 111 matrix of telephone calls for 1977 were used.

A. Mapping Flows

The simplest approach consisted of mapping all those flows between centres which attained a volume greater than 5% of the total outflow

Figure 2-1

Extended Area Dialling in Alberta


ALBERTA
EAS/EFRC ROUTES (EXISTING & PROPOSED)
EDMONTON INCLUDES
—EDMONTON CITY
—EDMONTON INT. AIRPORT
—ELLERSLIE
—NAMAO
—ST. ALBERT
—SHERWOOD PARK
GENERAL OPERATIONS — COMMERCIAL DEVELOPMENT & RURALS
JUL 1976

from the centre to all the 111 destinations. Since the volume of flows from any place varied according to the size of the centre there seemed little point in portraying volumes of flow since it would exaggerate the interchanges between big cities at the expense of identifying links between similar centres. Instead the flows from any origin were rank ordered according to their importance to that centre. All flows less than 5% of the total outflow from a centre were ignored as being of little general significance. Rather than using graph theory methods the first three largest ranks were given separate symbols and mapped (Figure 2-2); all other flows greater than 5% were shown by dotted lines. It is vital to avoid situations in which only a few telephone calls separated first, second or third ranks so flows were only given a separate rank category if they had a difference greater than 2% of the total flows; otherwise they were shown as shared flows.

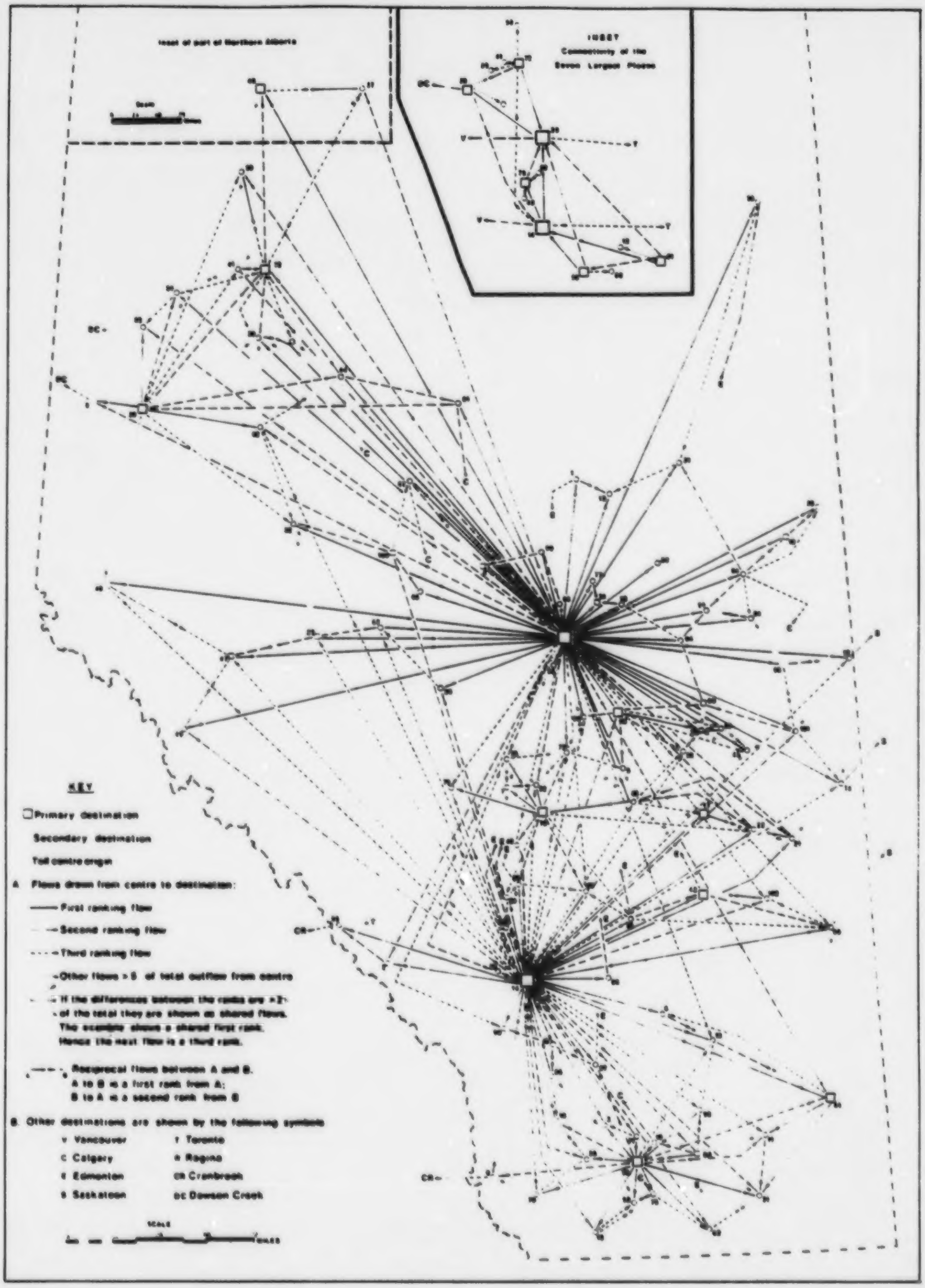
It will be shown that few places had more than three or four destinations to which they sent more than 5% of their flows. This means there was a very highly structured flow pattern in Alberta. Nevertheless, the number of these linkages does make it difficult to identify the general patterns, while the obviously arbitrary nature of the 'cut off' limits, and the fact that not all the data in the information matrix was used, all represent limitations of this cartographic approach. As a result recourse was made to a more sophisticated multivariate technique to define the pattern of connectivity.

B. Statistical Method

A wide variety of statistical methods of defining the structure of the functional connections between towns and regions have been proposed, ranging from Graph Theory (Nystuen and Dacey, 1961; Davies and Robinson, 1968); Cluster Analysis (Hirst, 1977); Transaction Analysis (Soja, 1968) and Markov Chain Analysis (Holmes and Brown, 1972). However, it does seem that Factor Analysis methods (Davies, 1970; Davies, 1972; Davies, 1979) represent the most useful and flexible approach to the problem (Davies, 1979). As with all multivariate methods a variety of technical decisions have to be explained before the results can be adequately assessed. Moreover it must be emphasized that the factor approach attempts to pick out the general structures

Figure 2-2

Rank Order Analysis of Telephone Calls 1977


Inset of part of Northern Alberta
INSET
Connectivity of the
Seven Largest Places
KEY
Primary destination
Secondary destination
Toll centre origin
A. Flows drawn from centre to destination:
First ranking flow
Second ranking flow
Third ranking flow
Other flows > 5 of total outflow from centre
If the differences between the ranks are < 2 of the total they are shown as shared flows. The example shows a shared first rank. Hence the next flow is a third rank.
Reciprocal flows between A and B. A to B is a first rank from A; B to A is a second rank from B
B. Other destinations are shown by the following symbols
V Vancouver
C Calgary
E Edmonton
S Saskatoon
T Toronto
R Regina
CR Cranbrook
DC Dawson Creek
SCALE
MILES

involved in any pattern, not the local idiosyncrasies in any one area. Hence a combination of simple mapping techniques and sophisticated generalization procedures should be enough to unravel the patterns of connectivity present in the area.

The procedures used in the factor analysis (Harman, 1975) can be described in terms of six decision stages (Table 2-2). The analysis used was the S.P.S.S. package programme (Nie et al, 1975).

1. The input data consisted of the 102 origin x 111 destination matrix of telephone calls.

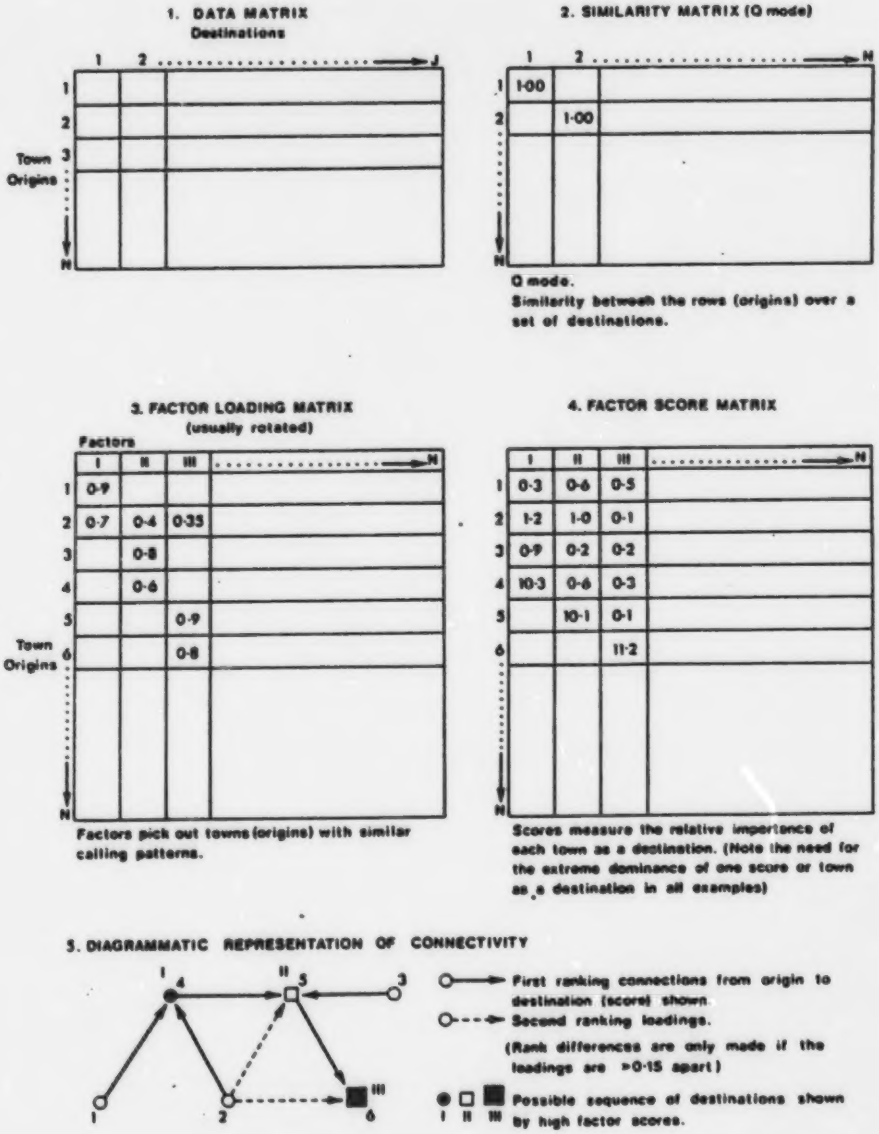
2. Pearson Product Moment Correlation Coefficients were calculated between each pair of rows or origins to produce a Q mode analysis. These correlations were chosen because they measured the degree of similarity between each pair of places in which the influence of absolute size is repressed in favour of relative size values for each variable (Davies, 1979). Transformations were not used since previous workers showed the effect was minimal (Clark, 1973 a and b).

3. A Principal Axes component analysis was carried out on the similarity matrix to reduce the 102 x 102 similarity to its latent dimensions. This method has been shown to produce results as good as the more sophisticated factor methods (Davies, 1978; Giggs and Mather, 1975) and has the advantage of not estimating commonalities or the numbers of common factors. These preliminary component results were followed by oblique (direct oblimin with gamma equal to 0.0) and orthogonal (varimax) rotations (Table 2-4).

4. A series of alternative solutions were scrutinized in the search for the best solutions. The key decision criteria used to decide on the final solution are shown in Tables 2-3a and 2-3b. The former shows a minor break in the distribution of variances associated with each factor after the fifth axis. However the table shows that a nine axis solution is needed before all the variables, in this case origins, have commonalities (explained variance) greater than 0.5. By the ninth solution many of the components have several places or destinations loading on an axis and many of these axes are quite highly correlated. So the decision was taken to use a six component solution since this accounted for the majority of the variance (86.1%) while only three places, Fort Vermilion, Youngstown and Killam had less than half their variance explained. Ten other places had commonalities less than 0.7 which meant that

Figure 2-3

Factor Analysis and Single Connectivity Matrices


1. DATA MATRIX
Destinations
1
2
J
Town Origins
1
2
3
N
2. SIMILARITY MATRIX (Q mode)
1
2
N
1·00
1·00
3. FACTOR LOADING MATRIX
(usually rotated)
Factors
I
II
III
N
4. FACTOR SCORE MATRIX
5. DIAGRAMMATIC REPRESENTATION OF CONNECTIVITY
I
4
II
5
3
1
2
III
6
I
II
III

Q mode.
Similarity between the rows (origins) over a set of destinations.

Town Origins	I	II	III
1	0·9		
2	0·7	0·4	0·35
3		0·8	
4		0·6	
5			0·9
6			0·8

Factors pick out towns (origins) with similar calling patterns.

	I	II	III
1	0·3	0·6	0·5
2	1·2	1·0	0·1
3	0·9	0·2	0·2
4	10·3	0·6	0·3
5		10·1	0·1
6			11·2

Scores measure the relative importance of each town as a destination. (Note the need for the extreme dominance of one score or town as a destination in all examples)

○⟶ First ranking connections from origin to destination (score) shown.

○- - -➝ Second ranking loadings.

(Rank differences are only made if the loadings are >0·15 apart)

● □ ■ (I II III) Possible sequence of destinations shown by high factor scores.

(From: Davies 1979)

Table 2-3

Criteria for Choice of Factor Solution for Alberta Telephone Calls

(a) First Order Solution

	Number of Axes Abstracted							
1) Communalities	4	5	6	7	8	9	10	11
>0.7	78	87	89 (89)	92	94	95	98	
0.5 to 0.7	18	11	10 (8)	8	7	7	4	
<0.5	6	4	3 (5)	2	1	0	0	0
2) Variance	80.7%	84.5%	86.1%	87.6%	88.6%	89.0%	89.9%	
Aided by Axis	4.6%	3.8%	1.6%	1.5%	1.0%	0.4%	0.9%	
3) Factor Correlations								
>0.25								
0.40								

(b) Higher Order Factor Results (Alberta 1977)

First Order Titles	Factor Loadings I	III	II	Communality
1. Edmonton	56* (69)		49	65
4. Grande Prairie	80 (81)			63
6. Peace River	85 (77)			70
3. Lethbridge		95 (62)		89
2. Calgary		48 (81)	60	67
5. Red Deer		(64)	91	81

Three (two) axis solution accounts for 72.5% (56.9% of variance. Second order loadings in brackets.

Factor Correlations:

	II	III
I	9	01
II	100	16
III		100

*Decimal points are excluded 56 = 0.56

Table 2-4

Component Scores from Direct Oblimin Solution: Alberta Telephone Calls 1977

		Number of Axes in Solution						
		4	5	6	7	8	9	10
1.	Edmonton	10.2	10.3	10.3	10.3	10.3		
2.	Calgary	10.1	10.3	10.2	10.3	10.4		
3.	Lethbridge	9.8	9.8	9.8	9.8	9.8		
	Calgary	2.7	2.8	2.9	2.9	2.4		
4.	Grande Prairie	5.6	7.3	9.6	9.6	9.6		
	Red Deer	-7.2	4.6 Edmonton	3.5	3.5	3.5		
			4.8 Peace River	---	---			
5.	Red Deer		8.7 Red Deer	8.7	8.8	8.9		
			3.4 Calgary	3.4	3.4	3.1		
			3.5 Edmonton	3.5	3.3	3.2		
6.	Peace River			Peace River 8.2	8.3	8.2		
				Edmonton 4.6	4.8	4.8		
				G. Prairie 2.3	2.4	2.3		
7.	Edmonton/ Camrose				Edmonton 7.1	7.0		
					Camrose 5.9	5.8		
					Sedgewick 2.3	2.3		
					Killam 2.0	2.0		
8.	Calgary/ Hanna					Calgary 5.5	5.2	
						Hanna 5.3	6.2	
						Stettler 3.9	3.5	
						Coronation 3.5	3.3	
						Edmonton 2.4	2.0	
9.	High Level/ Edmonton						High Level 8.8	9.9
							Edmonton 4.1	4.0
							Peace R. 2.1	2.2
10.	Stettler - Medicine Hat							Coronation -4.3
								Stettler -5.0
								Calgary -2.5
								Taber +2.2
								Medicine H. +4.9

30% of the variance of these places was not accounted for by the six axis model. In other words a lot of idiosyncratic or local flows are likely to be found in these centres. These places are:

5) Bashaw (.68)
11) Bow Island (.51)
17) Castor (.56)
21) Consort (.56)
56) Lake Louise (.59)
60) McLennan (.62)
64) Myrnam (.58)
67) Niton Junction (.56)
80) Sedgewick (.61)
93) Vauxhall (.67)

5. An alternative factor method, Image Analysis, followed by oblique rotation was also applied to the six factor solution. Basically very similar results were obtained except that more places had lower variance explanations meaning that the Image solution identified less of the overall variance. Hence, *the results were independent of Factor technique*.

6. Once the six axis factor analysis was completed a *Higher Order Factor Analysis* using identical procedures was applied to the 6 x 6 matrix of factor correlations (Cattell, 1968; Davies and Musson, 1978). Three higher order axes were needed to ensure that a majority of the variance was accounted for. Table 2-3b shows that two distinct axes were identified, a Northern Alberta vector accounting for the Edmonton, Grande Prairie and Peace River axes and a Southern Alberta one summarizing the Lethbridge axis and part of the Calgary vector. The third axis was associated primarily with Red Deer to which the first order Calgary and to a lesser extent the Edmonton axes were also linked with minor loadings. This result confirms the way in which Northern and Southern parts of the province are dominated by their metropolitan centres, together with the degree of overlap in the Calgary and Edmonton corridor. Basically, therefore, these higher order results produce a higher level of generalization from the data set than those produced by the first order factor results. This means that the variability associated with the 102 x 102 similarity matrix has been 'boiled down' by the factor analysis approach:

- firstly to 6 axes explaining 86.1% of the variance; and
- secondly to 3 axes accounting for 72.5% of the variation.

IV. EMPIRICAL PATTERNS OF CONNECTIVITY

The two sets of results from the Rank Order (Cartographic) and Factor Analysis approaches to the analysis of telephone calls are shown in Figures 2-3 and 2-4. Obviously the Factor Analysis map is much easier to interpret since the factor technique focuses upon the general structure of connectivity and ignores the minor, local patterns which are excluded from the model since they are considered to be error variance. Despite the superficial differences between the two maps a close scrutiny reveals that the basic patterns portrayed are in fact quite similar. The main divergence between the figures comes from the greater detail of the rank order analysis. In the following discussion, references are made to both maps in order to pinpoint the local, idiosyncratic features as well as the general structure. Six major features of the Alberta pattern are isolated: the limited connectivity of the towns; the general hierarchical structure; metropolitan dominance; regional nodality; minor structures; degree of self containment.

A. Limited Connectivity of Towns

In theoretical terms the possibility of a person in any one town being able to communicate by telephone with individuals in any other town could lead to a chaotic pattern of telephone calls since calls can be made from one centre to all other centres. In practice, the number of connections between any one centre and most other places is quite limited in relative terms. Although most places have some type of connection with all other centres, by far the greatest number of calls from any place are focused upon a handful of destinations. Table 2-5 shows the number of places in which 5% or more of the calls go to two, three, four, five and six destinations respectively. It can be seen that the modal group is four destinations. This means that almost three-quarters of the 102 centres in Alberta send most of their calls to four places or less. Fewer than ten percent of the places communicate significantly with six destinations; 'significance' relates to the 5% cut off measure. Even more telling is the fact that 40 of the 102 places have more than fifty percent of their calls to the two largest places, Calgary and Edmonton. If Grande Prairie, Red Deer, Lethbridge and Medicine Hat are added to the number of destinations the number of places with more than half their calls terminating in these centres rises to sixty-two out of 102. These results provide little support for the 'non-spatial

Figure 2-4

Factor Analysis of Alberta Telephone Calls 1977

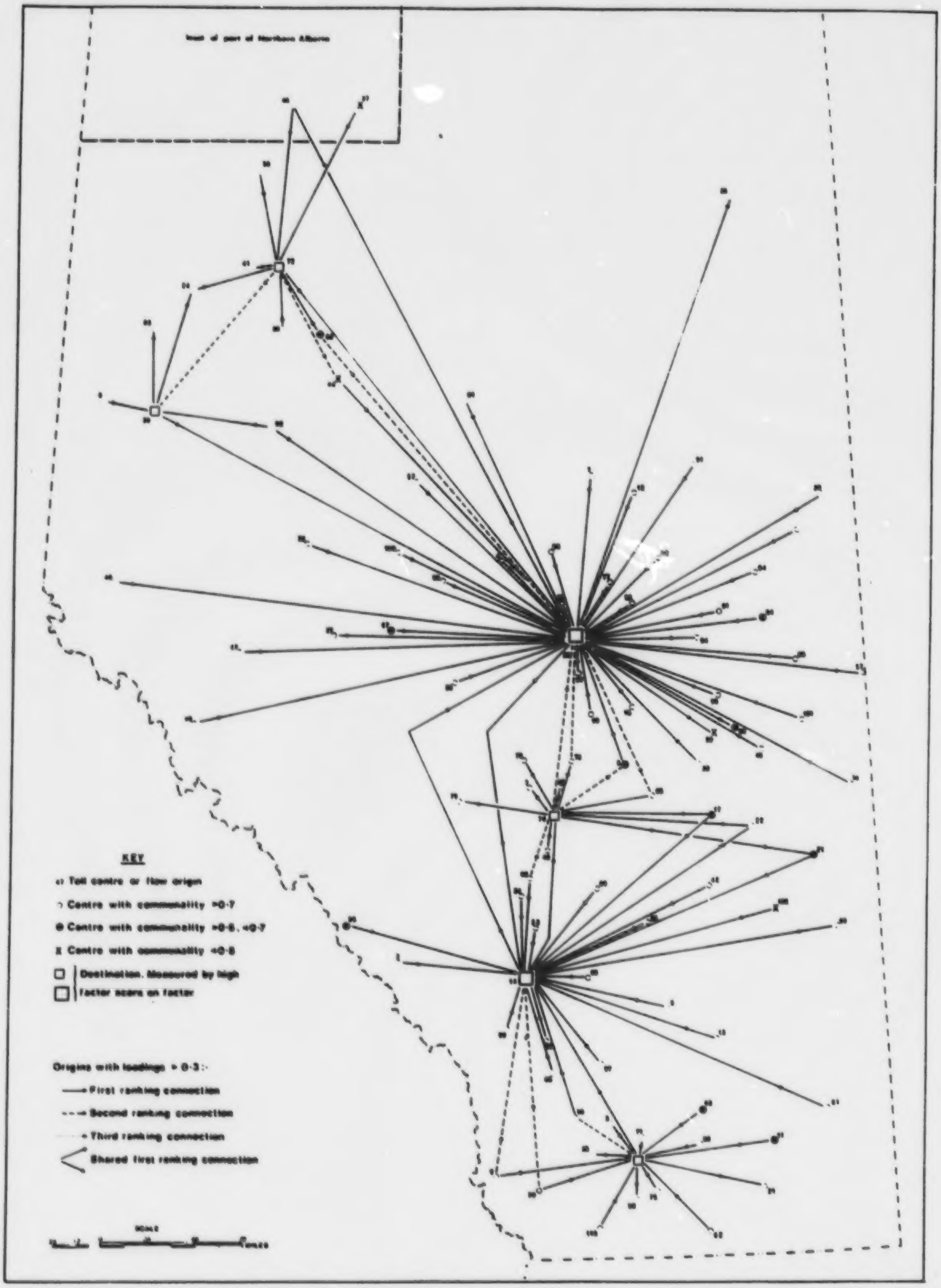

Inset of part of Northern Alberta
KEY
Toll centre or flow origin
Centre with communality >0·7
Centre with communality >0·6, <0·7
Centre with communality <0·6
Destination. Measured by high factor score on factor
Origins with loadings > 0·3:-
First ranking connection
Second ranking connection
Third ranking connection
Shared first ranking connection
SCALE
MILES

Figure 2-5

Theoretical and Empirical Flow Structures in Alberta: Comparison of the Factor Results and Huff's Model for Seven Centres

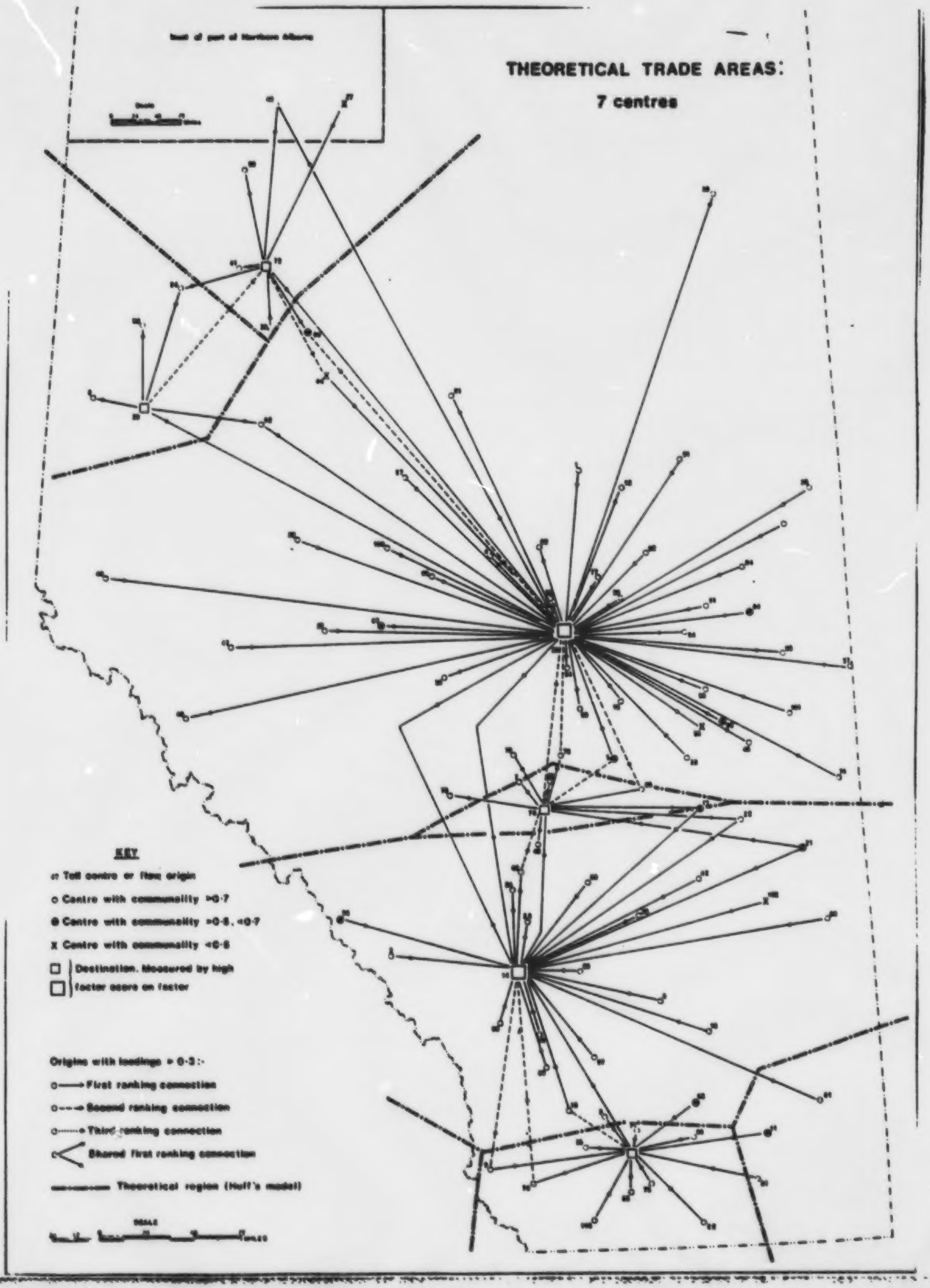

Inset of part of Northern Alberta
THEORETICAL TRADE AREAS:
7 centres
KEY
Toll centre or flow origin
○ Centre with communality >0·7
● Centre with communality >0·5, <0·7
X Centre with communality <0·5
Destination. Measured by high factor score on factor
Origins with loadings > 0·3:-
First ranking connection
Second ranking connection
Third ranking connection
Shared first ranking connection
Theoretical region (Huff's model)
SCALE

Table 2-5

Number of Call Destinations

Number of Call Destinations (Flows Greater than 5% of Total Calls from a Centre	Number of Alberta Centres in Category (Percentage)
2	16 (15.6%)
3	25 (24.5%)
4	32 (31.4%)
5	18 (17.6%)
6	11 (10.6%)

urban realm' postulated by Mel Webber (1964) for an electronic age, in which community of interests are formed between like-minded individual groups without reference to any geographical space. Undoubtedly new forms of communication enable closer contacts between people who are spatially dispersed and specialist groups may be perpetuated in this way. However the dominant connections, at least between town and town, shows a quite limited organization in relation to the majority of the flows recorded. The next question to be answered is whether this high degree of organization, a focusing upon a limited number of places, conforms to any spatial patterns.

B. General Hierarchical Structure

The pattern of inter-urban connectivity traditionally found in studies of telephone flows consists of a hierarchical sequence of flows: from small centres to regional nodes; from regional nodes to metropolitan centres; and from metropolitan nodes to national core areas (Pred, 1973; Friedman, 1972). To a very great extent the type of pattern is also found in Alberta; for example, in the south, Pincher Creek has its dominant connection with Lethbridge and this centre is linked to Calgary; in the north, Spirit River has its most important link with Grande Prairie and this is in turn connected with Edmonton (Figure 2-2 by rank order analysis or Figure 2-3 by factor loadings). At the metropolitan scale, however, Calgary and Edmonton have their most important connections with each other, before linking firstly with Vancouver and secondly with Toronto (inset to Figure 2-3). This type of reciprocal connectivity often characterizes the sequence of flows between adjacent metropolitan centres (Friedmann, 1972; Dunn, 1970) and is a significant additional element to the general hierarchical pattern of calls. Other types of exceptions to the general sequence can also be discerned in the pattern of calls in Alberta. One of these is the issue of metropolitan dominance.

C. Metropolitan Dominance

Despite the presence of a hierarchical structure to the pattern of inter-urban connectivity, Figures 2-2 and 2-3 show that in many areas the expected orientation to a regional node is missed out; instead the smaller centres are directly connected by their largest flow to the metropolitan centres. Elements of this metropolitan dominance can be found in southern Alberta where centres such as Lake Louise in the west, Blairmore in the southwest, Medicine Hat and Brooks in the southeast, as well as Oyen and Consort in the east have their most important connections with Calgary. However, it is in the north of the province that the effect of the metropolitan dominance is more easily appreciated, in this case associated with Edmonton. For example, towns are far removed from the provincial capital as High Level and Fairview to the northwest, Grande Cache and Jasper to the west, Fort McMurray to the northeast, Grande Centre and Lloydminster to the east and Provost to the southeast all have their dominant connections with Edmonton. In part this focusing of the dominant flows upon Edmonton demonstrates the way in which there are few large nodes in the northern area to compete with Edmonton. Yet even where large service centres exist they are not important enough to counteract the influence of Edmonton. This can be seen by the limited importance, or nodality, of such places as Camrose, Ponoka, Stettler, Vegreville and Lloydminster to the south and east of Edmonton (Figures 2-2 and 2-3).

D. Regional Nodes

Apart from the nodality of the metropolitan centres Lethbridge, Red Deer, Grande Prairie and Peace River are also identified in the factor analysis as important regional centres in which several centres have their most significant connections with these nodes. Lethbridge and Red Deer are the most important of these nodes. It is worth noting that both have their spheres of influence (as measured by towns connecting with these centres) orientated in an east-west fashion due to the competition from the metropolitan centres of Calgary and Edmonton to the north or south. Yet even the east-west extension does not allow them to capture the dominant flows from towns in the eastern extremities of the province. This is especially marked in eastern central Alberta where centres such as Castor, Hanna and Consort are orientated primarily towards Calgary, whereas Forestburg, Hardisty and Provost are linked to Edmonton.

Figures 2-2 and 2-3 show that in the northwest the Peace River area does not form an integrated nodal region in functional terms, that is one focused on the largest centre (Grande Prairie). Instead only half the centres have their dominant flows either to Grande Prairie or to High Prairie; the rest have their largest connection with Edmonton. This functional division of the area into two interior nodal centres and a high level of external connectivity confirms that Grande Prairie has been too weak to exclusively dominate the area, given the relative strength and proximity of Edmonton. To some extent this type of reasoning process can be extended to the Medicine Hat area, although with added emphasis. Medicine Hat does not appear as an important destination on the factor analysis map (Figure 2-3) and has only one dependent centre, Bow Island, with its largest flow focused on the City (39%) compared to the flows to Lethbridge (27%) or Calgary (11%). In part this finding is a function of the scale of the analysis employed. Most of the places in Medicine Hat's trade area, as shown by the patterns of largest newspaper sales (Davies, 1975, Figure 4), were too small to qualify for this analysis of telephone flows, or like Redcliff, were part of the E.A.D. system of Medicine Hat so that separate calling patterns could not be extracted. Although the pattern of flows in the southeast of the province can be explained, they still point to a weakness in the nodality of Medicine Hat compared with other regional centres of comparable size in Alberta.

This discussion, the role of the regional nodes, would not be complete without emphasizing the dependence of these centres upon the metropolitan places. All four have a significant secondary association with the metropolitan centre. To some extent this can be seen in the minor factor scores associated with each of the regional node factors or the hierarchical pattern of interchange itself. It is confirmed by the pattern of percentage rank orders shown in Figure 2-2; for example, Rocky Mountain House has its dominant link with Red Deer, a secondary link with Calgary, and a third ranking link with Edmonton.

A more convenient way of showing this pattern of dependence is via the higher order factor analysis (Davies and Musson, 1978). Three higher order factors were identified, one associated with "Northern Alberta", the other with "Southern Alberta", a third focused on Red Deer but with important linkages to both Edmonton and Calgary (Table 2-3b).

E. Minor Structures

1. Proximity Principle - So far the discussion has concentrated upon the general structure found in the patterns of interchange between Alberta towns. Inevitably these general structures do not represent the only pattern; local idiosyncratic features are also found. Obviously, these minor patterns will not be isolated by the factor analysis approach since this method picks out the general structures and relegates the rest of the variability to the unique variance category. However these local patterns must also be described if a complete understanding of the pattern of flows is to be obtained. To this end the map of ranked flows (Figure 2-2) is particularly useful.

Once the sequence of flows to the regional and metropolitan centres is removed from consideration the most frequently recurring pattern is the local interchange between neighbouring centres. In most cases this interchange is the third largest flow since the two largest flows go to the regional and metropolitan centres. Where regional nodes are missing, particularly in the resource towns found to the west, north and east of Edmonton, the second largest flow is to a neighbouring centre. In five isolated cases the neighbouring interchange is large enough to be either a single or shared first ranking connection, namely: Fort Vermilion to High Level; McLennan to Falher and Edmonton; Killam to Camrose and Edmonton; Castor to Coronation and Calgary; Youngstown to Hanna. In part these cases reflect the fact that isolated centres remote from nodal centres, and those on the boundaries of nodal regions, may show sufficiently split allegiences for the proximity or neighbouring principle to outweigh other forces.

2. Secondary nodes - The other minor structure that can be identified in Figure 2-2 is the focusing of some of the secondary flows from centres upon nodes other than those already identified. Twelve places are

the destination for secondary flows from more than one centre, thereby confirming these places as secondary nodes since the nodality involves more than the proximity principle. Most of these places are found in an east-west belt north and west of Edmonton: Bonnyville, Ft. Saskatchewan, Westlock, Barrhead, Edson and Hinton. Given Edmonton's dominance in the area and the absence of competing regional nodes these are the centres that have some minor additional nodality. To the south centres such as High River and Camrose also fall into this category as do Castor, Hanna and Taber which act as destinations for the poorly developed central place system in the eastern dry belt of Alberta. Since the pattern of flows in the area west of Red Deer appears less structured than those elsewhere, in the sense that more linkages with smaller centres are found in the area, it could, perhaps, be postulated that the pattern is a relict one. In other words, the pattern represents the last vestiges of a more decentralized pattern where a much greater orientation of the local linkages focused on the smaller service centres. A temporal analysis would be needed to solve this question and this is clearly outside the scope of the report.

F. Degree of Self Containment

The final issue to be dealt with concerns the degree of self containment of the province in this measure of connectivity. Obviously no province or country is isolated; all have various degrees of exchange with the rest of the world. To ignore cross-border flows means that a closed system approach is adopted. In this study the nature of the linkages of the largest places with the metropolitan and national core areas has already been noted. Figure 2-2 shows that the related pattern, cross border connections, is not a major structure. It is apparent that some of the Peace River communities have second or third ranking linkages with Dawson Creek. Similar minor associations are found between Cranbrook and centres in southwestern Alberta, while Saskatoon is an important secondary or tertiary link with some of the eastern border centres. Nowhere, however, do the cross border linkages dominate the pattern of interchange from any of these 102 Alberta Centres.

V. THEORETICAL TRADE AREAS IN ALBERTA

For the past thirty years most theoretical interaction models and trade areas have been calculated on the basis of Reilly's 'laws' of retail gravitation in which the interaction between cities varies directly with the relative size of the centres and declines with the square of the distance (Issard, 1960). Most of the early criticisms of the Reilly approach, particularly the so-called 'breaking point' model used to define trade areas have concentrated upon the problems caused by the measurement of urban size (population, retail size, etc.), distances (straight line, time or cost measures) and the power used for distance (square, cube,etc.). Huff (1972), however, pointed to another major difficulty, the fact that Reilly's model only compared two centres at a time, whereas in the real world several alternative centres could usually be chosen by any person. Huff's re-formulation of the trade area model took the following form.

$$P_{ij} = \frac{\dfrac{S_j}{D_{ij}^{x}}}{\displaystyle\sum_{j=1}^{n} \frac{S_j}{D_{ij}^{x}}}$$

where: S_j = Size of place j in an 'n' city area;

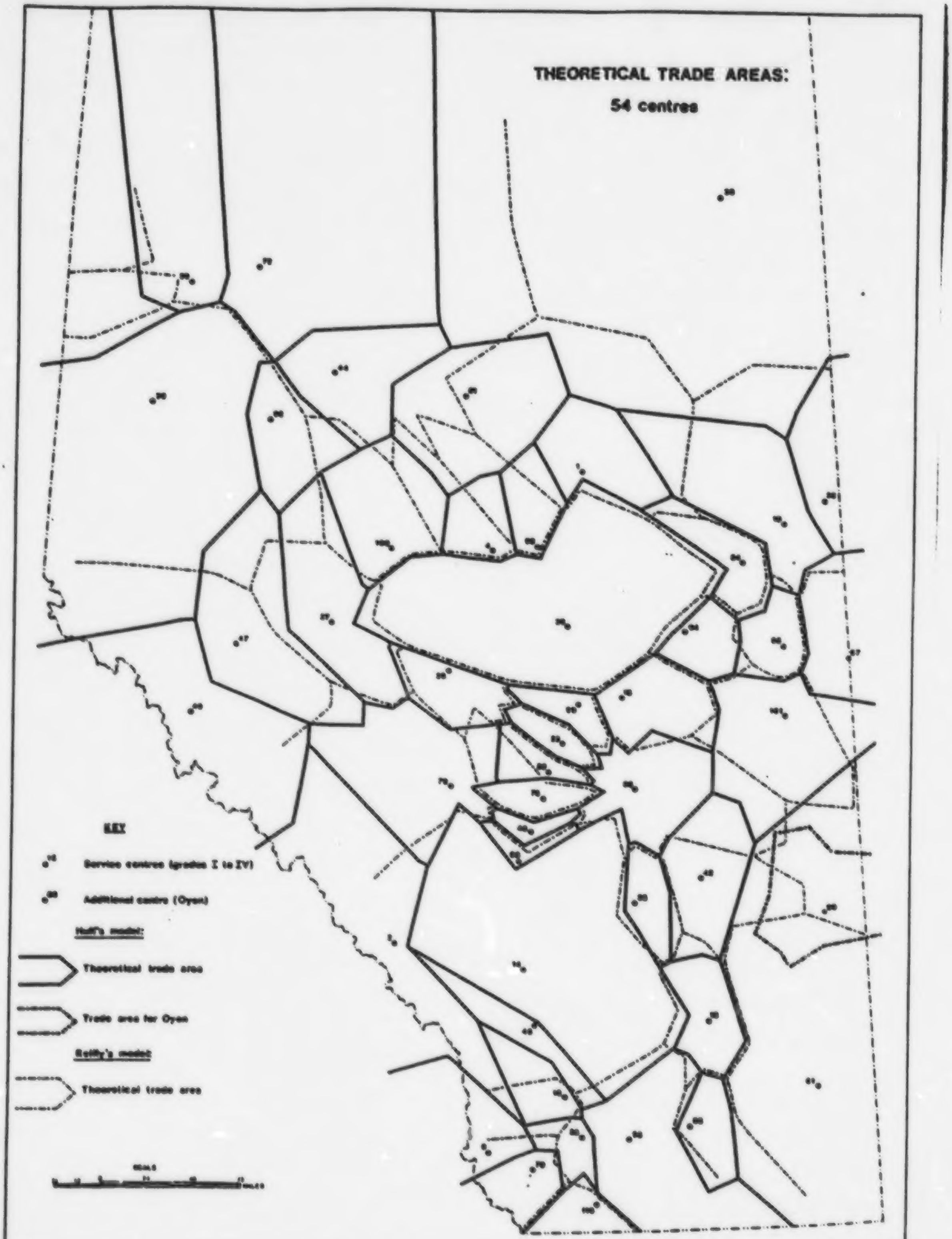
D_{ij} = Distance between i and j;

x = exponent applied to distance D.

In essence Huff's formula calculates the probability of the interaction from city i to j by measuring its size (S_j) discounted by distance Dij (usually powered (x) by the square of the distance). This is divided by the sum of the attractiveness measures $\sum_{j=1}^{n} (S_j/D_{ij}^{x})$ for all other cities. The breaking point is 50/50 line where the probability between i and j is equal. Two separate calculations were made at different scales, one applying the Huff model to seven Alberta towns (Figure 2-4) the other (Figure 2-5) to the largest 54 places (See Grades 1, 2, 3, 4 in Chapter 4). In both cases population was used as the size measure together with straight line mileages with an exponent of 2

Figure 2-5

Comparison of Huff and Reilly Model Results in Alberta


THEORETICAL TRADE AREAS:
54 centres
KEY
Service centres (grades I to IV)
Additional centre (Oyen)
Huff's model:
Theoretical trade area
Trade area for Oyen
Reilly's model:
Theoretical trade area
SCALE
MILES

as the distance values. Metropolitan or regional centres outside Alberta were added to the analysis for the sake of completion; Vancouver, Great Falls, Regina and Saskatoon for the seven centre analysis; and these centres plus Dawson Creek and Cranbrook for the fifty four centre study.

In Figure 2-4 the theoretical trade areas show a remarkably good fit to the basic structure of the interaction pattern as revealed by the factor analysis interpretation. Of the 102 Alberta centres all but nine are allocated to the appropriate trade area but three of these (Vauxhall, Bow Island, McLennan) have communalities below 0.7 which means that the factor interpretation does not deal with as much of the variability in these flows as the other centres. Of the nine misclassified places all lie within ten miles of the trade area boundary. Four of these are in the Red Deer area where the theoretical trade area is smaller than that produced by the empirical analysis. Another three lie in the Medicine Hat area. Medicine Hat is one of the centres. While Bow Island has its largest intersection with the Centre (Figure 2-2) and Foremost is misclassified because straight line not road distance is given. So the apparent distortions can be explained. In terms of the strictest comparison with the factor results the Medicine Hat area should not have been included in the Huff formulation because Medicine Hat was not identified as a separate destination in the factor study. However it has already been noted that the failure to identify Medicine Hat was primarly a consequence of the data restriction to 102 centres and the absence of large enough south-eastern places to be included in the south-east; therefore, it was appropriate to include the city. Three of the other misclassified places, Barons and Vauxhall, lie just outside the Lethbridge area and the other, McLennan, is outside Peace River. As in the Red Deer case these results suggest that the great discrepancy between the size of population for Calgary and Edmonton and the next level of Regional Centres produces larger trade areas than the empirical study has revealed. Figure 2-4 also shows that four other places, have shared first ranking connections with the following pairs of places: Grande Prairie and Peace River in the case of Fairview; Grande Prairie and Edmonton for Valleyview; Red Deer and Calgary in the case of Coronation and Consort. In all four cases the centres are exclusively allocated to one area, rather than being on the boundary line as suggested from the factor results, although this is a relatively minor distortion from the theoretical predictions. Yet despite these exceptions the fact remains that the comparison of the factorial and theoretical trade area results shows a very high degree of correspondence between the two studies, one perhaps that could be improved if road rather than straight distance was employed as the distance measure. Yet although this study demonstrates a close fit between the theoretical and empirically derived trade areas it is worth remembering that the empirical results only represent the general structure at one scale of analysis. The detailed local patterns found in Figure 2-2 were factored out of the multivariate analysis shown in Figure 2-4, while Huff's formulation only applies to one scale of analysis at a time, in this case seven Alberta centres.

Figure 2-5 takes the evaluation of the Huff model in the Alberta context one stage further. In this example the trade areas of 54 centres are calculated, the fifty-two largest places plus Blairmore in the Crows Nest Pass and Oyen in the dry belt of the east. These trade areas are compared with the most similar set of regions produced by the formulations obtained from the application of the less sophisticated Reilly model (Dept. of Municipal Affairs, Planning Services Division Maps 1973).

Although there is a good fit between the empirical and theoretical analysis at the seven centre level the close relationship breaks down in the fifty-four centres analysis (Figure 2-5) for most of these centres "carve out" their own trade areas within the higher order trade areas shown in Figure 2-4. In certain areas, such as the mountainous west or the north, the theoretical regions may not conform too closely to reality, given the influence of a restricted road network and the sparse population. For example the theoretical trade area for Banff is orientated in the northeast/southeast axis beyond the areas normally communicating with the centre. Nevertheless, despite these distortions, which would only be eradicated by using road mileage as the measure of distance, the pattern of regions does confirm some of the characteristics of interaction in Alberta that have already been mentioned. The most obvious point is the way in which Edmonton and Calgary dominate their immediate environment although the trade area of the former is orientated in an east-west direction rather than the northwest-southeast alignment of the latter. The size of Medicine Hat's trade area is very surprising but this is obviously cut down considerably if Oyen is added into the analysis. Also of vital importance is the way in which the competition between places in the Calgary-Edmonton corridor produces a series of small trade areas and squeezes them into east-west alignments.

Comparison of these theoretical areas with the regions produced by the less sophisticated Reilly Model (Dept. of Municipal Affairs, Planning Service Division Maps 1973) led to a surprising degree of similarity - given the limitations of the Reilly formula in which only pairs of towns were used in the identification of the trade areas. Figure 2-5 shows that most of the differences come from the fact that the most comparable Municipal Affairs maps (1973) consisted of 46 centres. The additional places analyzed here were: Slave Lake, High River, Crows Nest Pass, Bann, Olds, Valleyview and Fairview while Oyen was on the Municipal Affairs map but was only used as an alternate in the Huff formulation. Each of these places have theoretical areas defined in Figure 2-5 that are not shown on the Municipal Affairs map. In addition, other centres all have much bigger trade areas than expected, for example Ft. McMurray, Hinton, Wainwright, and Rocky Mountain House, a reflection more of the increased relative size of these places over the 1971-77 period than anything else. By contrast Athabasca and Stettler have smaller areas due to the competition provided by Ft. McMurray and Slave Lake in the former case and Hanna and Wainwright in the latter. Yet despite these exceptions the two sets of areas show a remarkable degree of correspondence given the difference in method between the two studies. In other words a high degree of confidence must be placed in the utility of the theoretical formulations for identifying at least the general structure of trade areas and connectivity in the Province of Alberta.

VI. CONCLUSION

It is worth re-emphasizing that this analysis has only used one of the potential measures of interaction between Alberta towns, namely telephone calls. Nevertheless, the results give investigators a vital clue to the pattern of interaction between Alberta centres and the pattern of trade areas in the province. It would be trite to re-emphasize the metropolitan dominance of the interaction pattern; what may be more revealing is the way Edmonton and Calgary have supressed the development of minor centres of nodality in their spheres of influence, and often truncated a lengthy hierarchical sequence of flows from minor to larger centres. Moreover the high degree of order in the network, as revealed by very high concentrations of flow to a limited number of places, tends to parallel the rather simplistic pattern of connectivity found in Alberta. In general, therefore, it can be concluded that quite limited place-based interaction patterns still form the basic structure of the system of connectivity between towns in the province. Only in the parkland/dry belt area of east central Alberta are there major exceptions to the general structures that have been identified.

REFERENCES

Black, W.R. (1973), 'Toward a Factorial Ecology of Flows'. Economic Geography, vol. 49, pp. 59-67.

Brown, L. and Holmes, J., (1971), 'The Delimitation of Functional Regions', Journal, Regional Science, 1, pp. 57-72.

Cattell, R.B. (1968), 'Higher Order Factor Structures', in C. Banks and P.L. Broadhurst, (eds), Studies in Psychology: Essays Presented to Cyril Burt, London.

Clark, D. (1973a), 'Normality, Transformation and the Principal Component Solution'. Area, vol. 5 (2), pp. 110-113.

Clark, D. (1973b), 'The Formal and Functional Structure of Wales'. Annals, Assoc. of Am. Georgraphers, 63, pp. 221-238.

Christaller, W.W. (1932, translated C. Baskin, 1964), Central Places in S. Germany. Prentice Hall.

Davies, W.K.D., (1972), 'Conurbation and City Region in an Administrative Borderland'. Regional Studies, No. 6, pp. 217-236.

Davies, W.K.D. and Gyuse, T. (1975), Changes in the Central Place System Around Calgary, in B. Barr (Ed.), Calgary, Western Geographical Series No. 19, pp. 123-157.

Davies, W.K.D. and Lewis, C.R. (1970), 'Regional Structure in Wales', Chapter 2 in 'Urban Essays: Studies in the Geography of Wales', Longmans, U.K.

Davies, W.K.D. and Barrow, G. (1973), 'A Comparative Factorial Ecology of Three Canadian Cities', Canadian Geographer, 17(4), pp. 327-357.

Davies, W.K.D. and Musson, T. (1978), 'Spatial Pattern of Commuting in South Wales, 1951-71'. Regional Studies, 1978 (forthcoming).

Davies, W.K.D. and Robinson, G.W.S. (1969), 'The Nodal Structure of the Solent Region'. Journal, Town Planning Institute, Vol. 54, pp. 18-23.

Davies, W.K.D. (1979), 'Urban Connectivity in Montana'. Annals, Regional Science (forthcoming).

Davies, W.K.D. (1977), 'Higher Order Factor Analysis and Functional Regionalization'. Discussion paper, Department of Geography, University of Calgary.

Davies, W.K.D. and Thompson, R.R. (1977), "Dyadic Factor Analysis and the Prairie Urban System Connectivity". Paper read at Western C.A.G. Conference (Edmonton, 1977).

Dunn, E.S. (1970), "A Flow Network Image of Urban Structure", Urban Studies, Vol. 7 (3), pp.

Friedmann, J. (1972), 'A General Theory of Polarized Development', in N.M. Hansen (Ed.), Growth Centres in Regional Economic Development, Free Press, pp. 82-107.

Giggs, J.A. and Mather, P.M. (1975), Factorial Ecology and Factor Invariance, Economic Geography, 51 (4), pp. 366-382.

Harman, H.H. (1975), Modern Factor Analysis. University of Chicago Press, Revised Ed.

Holmes, J. (1975), 'Graph Theory and Transactions Flow Analysis Applied to Flow Matrices'. Mimeo, Department of Geography, University of Queensland.

Hirst, M.A. (1977), 'Hierarchical Aggregation Procedures for Interaction Data: A Comment, Environment and Planning A, Vol. 9, pp. 99-103.

Horton, F. (1966), in Leopold, L.B. et al, Fluvial Processes in Geomorphology, Freeman, pp. 131-150.

Huff, D., (1973), 'The Delimitation of a National System of Planning Regions ...' Regional Studies 7, pp. 323-329.

Illeris, S. and Pederson, P.O. (1968), 'Central Places and Functional Regions in Denmark: A Factor Analysis of Telephone Traffic'. Land Studies in Geography, Series B., No. 31.

Nie, N., Brent, D.H. et al (1975), Statistical Package for the Social Sciences, McGraw Hill, New York, Revised Edition.

Nystuen, J.D. and Dacey, M.F. (1961), 'A Graph Theory Interpretation of Nodal Regions'. Papers, Regional Science Association 7, pp. 29-42.

Pred, A.(1973), 'Systems of Cities', Lund Studies in Geography, Series B., 38, pp. 9-82.

Preston, R.E. (1972), 'The Structure of Central Place Systems', Economic Geography, 48, pp. 136-155.

Rummel, R.J. (1971), Applied Factor Analysis, Northwestern University Press.

Simmons, J. (1976), Canada as an urban system, Ekistics, Vol. 41, pp. 68-75.

Soja, E.W. (1968), 'Communications and Territorial Integration in East Africa'. East Lakes Geographer 4, pp. 39-59.

Thompson, R.R. and Davies, W.K.D. (1977), 'Dyadic Factor Analysis and the Prairie Urban System'. Paper presented at C.A.G. Annual Meeting (Regina), 1977.

Webber, M. (1964), The Urban Place and Non Place Urban Realm, in M. Webber et al (ed),'Explorations into Urban Structure', Univ. of Pennsylvania Press.

CHAPTER 3

ECONOMIC BASE CHARACTERISTICS OF ALBERTA TOWNS IN 1971

I. INTRODUCTION

One of the basic requirements of any comprehensive service centre study is the definition of the variations in the economic character to places. In a descriptive sense the measurements enable investigators to understand the economic idiosyncrasies of places and perhaps to identify regional variations in economic patterns. In a prescriptive context the measurements identify the economic imbalances which enable planners to pinpoint areas of future economic stress and, by temporal study, to measure changes resulting from specific policies. A particular derivative of the prescriptive approach has been to measure the basic: non-basic ratio for towns, namely the ratio of employment in city export activities, to those in city service activities in order to estimate the changes in future economic growth using multiplier concepts.

In this study only the descriptive approach will be used--primarily because the analysis has to be restricted to the information derived from the 1971 census. Since this information is obtained from the unpublished enumeration area data tapes the computation of this data represented a major task in its own right. (The hope is that the information will be processed in the same way after the 1981 census in order to measure changes in the economic character of Alberta towns). Beyond the compilation of this data the objectives of this study, therefore, are:

- to measure the degree of economic specialization of centres using Gini coefficient techniques and to compare these values to other characteristics of places; and
- to identify the degree of specialization of each type of industry in the centres using Location Quotient or Index of Local Specialization as well as Index of Surplus Labour techniques.

Since the interpretation of these measures depends heavily upon an appreciation of the basis of the various calculations, it is necessary to describe the data and techniques in some detail. As a result the chapter is divided into three sections dealing with: data and techniques; degree of economic specialization; and degree of industrial specialization.

Before dealing with these issues it is worth noting that the calculation could be used to derive the excess or 'export' employment in any centre so as to produce a measurement of the basic/non-basic ration. This is not attempted here because it is beyond the scope of the study as defined in the feasibility study. In any case, the restriction of the analysis to a data set obtained from the last census (1971) causes major problems, the most important being that the most detailed economic breakdown for small towns consists of a 12 industry data set. This is really too gross a level of aggregation for meaningful basic/non-basic calculations, given a recent study which shows the dependence of economic base calculations upon the scale of degree of detail of the industrial breakdown.

II. DATA AND TECHNIQUES

A. Data

The 1971 Federal census is the most recent comprehensive data source on the industrial structure of towns, where 266 individual classes of industry are identified. However, confidentiality restrictions mean that the detailed breakdown is only available for the largest centres and even for towns with a population greater than 10,000 the industrial breakdown is restricted to 52 categories of industry (Table 3-1). These restrictions mean that no published information is available for small towns. Fortunately, the unpublished Enumeration Area tapes for the 1971 census contain at least a summary indication of the variations in industrial structure and have been made available at the University of Calgary (Davies 1974). Table 3-1 shows that the employment in twelve industrial categories can be identified and information for these categories was compiled for as many small towns as possible. The Fishing category, however, was excluded since too few people for any worthwhile analysis were employed in this activity in Alberta. Since the smallest centres of all only form part of an enumeration area, which then extends over a wide rural area, it was not possible to accumulate information for all the centres in this study. Only those centres with enumeration areas restricted to the political or built up centre were considered for analysis. In practice this meant that the economic base study was restricted to the first six categories (Groups I to VI) of the central place hierarchy (Chapter 4). Out of these 117 centres some of the enumeration areas involved extended over large rural tracts so the definitions of the areas were not comparable. In all, 13 centres had to be excluded from the analysis leaving a total of 104 places in the study.

Table 3-1

Standard Industrial Codes for Industrial Employment 1971

Economic Activity Sector	12 Class Code	52 Class Code
PRIMARY		
	1 Agriculture	
	2 Forestry	1 Forestry Services
	3 Fishing and Trapping	
	4 Mines, Quarries and Oil Wells	2 Metal Mines
		3 Mineral Fuels
		4 Non-Metal Mines
		5 Services to Mining
SECONDARY	5 Manufacturing Industries	6 Feed Ind. & Farm Services
		7 Food and Beverage Ind.
		8 Tobacco Products
		9 Rubber & Plastic Products
		10 Leather Ind.
		11 Textile Ind.
		12 Knitting Mills
		13 Clothing Ind.
		14 Wood Ind.
		15 Furniture & Fixture Ind.
		16 Paper & Allied Ind.
		17 Printing, Publishing and Allied Ind.
		18 Primary Metal Ind.
		19 Metal Fabricating Ind.
		20 Machinery Ind.
		21 Transport Equipment Ind.
		22 Electrical Products Ind.
		23 Non-Metallic Mineral Products
		24 Petroleum & Coal Products
		25 Chemical & Chemical Products
		26 Miscellaneous Manufacturing
	6 Construction Industries	27 Construction Industries

Table 3-1

Standard Industrial Codes for Industrial Employment 1971

Economic Activity Sector	12 Class Code	52 Class Code
TERTIARY	7 Transportation, Communication and Other Utilities	28 Transportation
		29 Storage
		30 Communications & Other Utilities
	8 Trade (Wholesalers)	31 Petroleum Products
		32 Food
		33 Drugs & Toilet Preparations
		34 Apparel and Dry Goods
		35 Motor Vehicle & Accessories
		36 Electrical Machinery, Equip. and Supplies
		37 Farm Machinery & Equipment
		38 Machinery and Equipment
		39 Hardware, Plumbing and Heating Equipment
		40 Lumber & Building Materials
		41 Scrap & Waste Materials
		42 All Other Wholesalers
	(Retailers)	43 Food & Spirit Stores
		44 General Merchandise
		45 Automotive Products
		46 Apparel & Shoe Stores
		47 Hardware Stores
		48 Household Furniture and Appliances
		49 Other Retail Stores
	9 Finance, Insurance & Real Estate	50 Finance, Insurance and Real Estate
	10 Community, Business & Personal Service Ind.	51 Community, Business & Personal Service Ind.
	11 Public Admin. & Defence	52 Public Admin. & Defence
	(12) Unspecified & Undefined Ind.	

Apart for the data for each small town the calculation of economic base statistics requires the use of some base from which to measure the variations in each individual centre. Various choices have been made by investigators using the technique, ranging from national to regional totals. Given the objectives of this study it was considered to be most practical to use the labour force or employment totals for Alberta as a whole as well as similar totals for each city. Also, Prairie regional totals were used as an additional source of comparison for the Gini coefficient calculations.

Finally, it is worth noting that as with all enumeration area data randomization procedures were employed by the census authorities to preserve confidentiality. Hence the last digit of the data was changed to either a zero, a five or by adjusting the last two digits to a ten. This procedure was not considered to provide a serious distortion for the size of town being investigated here, but it would increase the risk of error if even smaller centres, down to perhaps 200 in population, were used. This provided another justification for the 'cut-off' at the Group VI level.

B. Techniques

Carter (1975) has succinctly reviewed the very wide variety of alternative techniques that have been used to measure the economic characteristics of places. Among the most popular of the more sophisticated measures that have been used the Minimum Requirements approach (Dacey and Ullman, 1961; Maxwell, 1965) suffers from the disadvantage of making quite arbitrary assumptions about the basic/non-basic component in any occupational type. In addition, the Cluster (Smith, 1965) and Factor Analysis methods (Berry, 1975) are not really appropriate here since they are more suitable for defining the general similarity of places, in the former case by identifying groups of towns, in the latter by the descriptive dimensions of centres as a prelude to scaling towns along these dimensions. In both cases the local variations of places tend to be lost. No satisfactory relationship is ever made between the occupational profile of a town and the general national or provincial profiles. This latter approach is the great strength of the location quotient measures where the economic profile of a centre is explicitly compared to the general profile in an attempt to identify the various specializations that can be found.

The three measures used are:

- The Index of Local Specialization (location quotient) which measures the degree of specialization of each occupation in the town to a national average;
- The Index of Surplus Workers (which translates the local specialization into numbers of workers and identifies the surplus or deficit of places;
- The Gini Coefficient which measures the overall degree of economic specialization in a centre.

In recent years a revival of interest in these ideas has taken place. For example, Pratt (1968) and Marshall (1975) have illustrated that the explicit relationship of local with national or provincial profiles provides a precise and understandable basis for the measurement of economic character.

The following is a simple case study of the way in which the three indices are calculated for City C in a 5 industry situation. Exactly the same calculations are provided for the 11 occupations x 104 centre study of Alberta using Provincial Industry totals.

The Index of Local Specialization

Calculate the ratios between each industry "i" and the total employment "t" for (i) the nation (ii) the city

(i) $\frac{Ei}{Et} = \frac{\text{Employment in Industry i in the nation}}{\text{Total employment in the nation}}$

(ii) $\frac{ei}{et} = \frac{\text{City Employment in Industry i}}{\text{Total Employment in the city}}$

These two ratios are related together for each industry "i" by dividing the city ratio by the national ratio i.e. $\frac{ei}{et}$ divided by $\frac{Ei}{Et}$. This produces an index of local specialization for industry i.

Taking the example of the retail industry in the table above we obtain

(i) $\frac{Ei}{Et} = \frac{50,000}{200,000} = 0.25$ (ii) $\frac{ei}{et} = \frac{4,000}{10,000} = 0.40$

(iii) $$\frac{\frac{ei}{et}}{\frac{Ei}{Et}} = \frac{0.40}{0.25} = 1.60$$ = Index of Local Specialization for the Retail Industry in City C.

It is clear that the construction of the index in this way enures that a measurement of the degree of local specialization in any industry is derived and that industries scoring an index value of over 1.0 have a greater degree of specialization in their employment structure than the national average.

Example:

Industries	Total Number Employed Nation	 City C	(i) National Ratio Ei/Et	(ii) Local Ratio ei/et	(iii) Index of Local Specialization $\frac{ei/et}{Ei/Et}$
Food	40,000	600	0.20	0.06	0.30
Chemical	80,000	3,000	0.40	0.30	0.75
Metals	10,000	400	0.05	0.04	0.80
Construction	20,000	2,000	0.10	0.20	2.0
Retail	50,000	4,000	0.25	0.40	1.6
Total	200,000	10,000			

The Index of Surplus Workers

The assumption behind the index of surplus workers is that the proportion of workers in any industry "i" has the same value as the proportion of total city workers to total national employment. This also is derived by dividing the city employment by the national employment i.e. $\frac{et}{Et}$.

If the total number of workers in any industry "i" is multiplied by this ratio the expected number of local workers in that industry "i" is obtained: $\frac{et}{Et} \cdot Ei$

By comparing this expected value with the actual employment in that industry "i" the number of surplus (or deficit) workers is calculated: -

$$ei - \frac{et}{Et} . Ei$$

A worked example for the construction industry may make the calculations of Table 2 easier to understand.

(i) $\frac{et}{Et} = \frac{10,000}{200,000} = \frac{1}{20}$

(ii) $\frac{et}{Et} . Ei = \frac{1}{20} . 20,000 = 1,000$

(iii) $ei - \frac{et}{Et} . Ei = 2,000 - 1,000 = +1,000$

Hence if the assumption of this formula are accepted the construction industry in City "C" has a surplus of 1,000 workers over the expected value.

Example:

Industries	(i) City: Nation Wide	(ii) Expected Employment $\frac{et}{Et} . Ei$	Actual Employment	(iii) Surplus Employment $ei - \frac{et}{Et} - Ei$
Food	1/20	2,000	600	-1,400
Chemicals	1/20	4,000	3,000	-1,000
Metals	1/20	500	400	- 100
Construction	1/20	3,000	2,000	+1,000
Retail	1/20	2,500	4,000	+1,500

Gini Coefficients

The Gini Coefficient is designed to measure the degree of industrial specialization of a City. It is most easily visualized by means of the following graph. In this way, the vertical axis measures the cumulative percent of the labour force in City 'A', the horizontal axis measures the cumulative percent of the labour force in the nation. It is important to note that the industries are ranked in order of their location quotients. The percentage for the industry with the highest location quotient is nearest the origin. The resulting curve provides a visual impression of the degree of specialization of a city, since more specialized cities have curves at greater distances from the diagonal. The deviation of a city's profile from this diagonal provides an indication of the overall specialization of a city. The geometrical representation of the index is not, however, the most efficient way of dealing with the degree of specialization. The following formula provides an exact measure of the degree of specialization:

$$G_j = \frac{\sum_{i=1}^{n-1} C_i D_{i+i} - D_i C_{i+1}}{10{,}000}$$

Where: C_i is the cumulative percentage of the labour force in industry i for the city

D_i is the cumulative percentage of the labour force in industry i for the nation

n is the number of industries ranked in order of their specialization as measured by their location quotients

The stages in the calculation of the index are as follows:

(a) Calculate the percentage of the labour force in each industry for the city and the nation (example) region/province.

(b) Calculate the location quotients for the industries in the city (example).

(c) Rank the industries in order of their location quotients and re-order the table of city and national percentages as shown in the example.

(d) Work out the cumulative percentages for the city and the nation (example).

(e) Multiply the cumulative percentage for the most specialized industry in the City C_i by the cumulative percentage for the second most unspecialized industry in the nation (D_{i+1}).

(f) Multiply the cumulative percentage for the most specialized industry in the nation D_i by the second most specialized industry in the city (C_{i+1}).

(g) Subtract the value of step (e) from step (f), i.e. $(C_i \, . \, D_{i+1}) - (D_i \, . \, C_{i+1})$.

(h) Repeat steps (e), (f) and (g) n-1 times as shown in the third example and add the differences between the calculations.

i.e. $$\sum_{i=1}^{n-1} (C_i \, . \, D_{i+1}) - (D_i \, . \, C_{i+1})$$

(i) Divide the product of step (h) by 10,000, i.e. the product of 100 x 100, which represent the two percentage distributions.

(j) The result is G the Gini coefficient or index of specialization for a city over a set of industries. This runs on a scale from 0.0 (least specialized) to 1.0 (complete specialization).

Example:

Percentages and Location Quotients from Local Specialization Index Example:

Industries	Percentages		Location Quotients	Rank
	Nation	City		
1. Food	20%	6%	0.30	5
2. Chemicals	40%	30%	0.75	4
3. Metals	5%	4%	0.80	3
4. Construction	10%	20%	2.00	1
5. Retail	25%	40%	1.60	2
Total	100%	100%		

Re-ordered Percentages:

Industries	Percentages		Cumulative %	
	City	Nation	C_i	D_i
1. Construction	20%	10%	20%	10%
2. Retail	40%	25%	60%	35%
3. Metals	4%	5%	64%	40%
4. Chemicals	30%	40%	94%	80%
5. Food	6%	20%	100%	100%

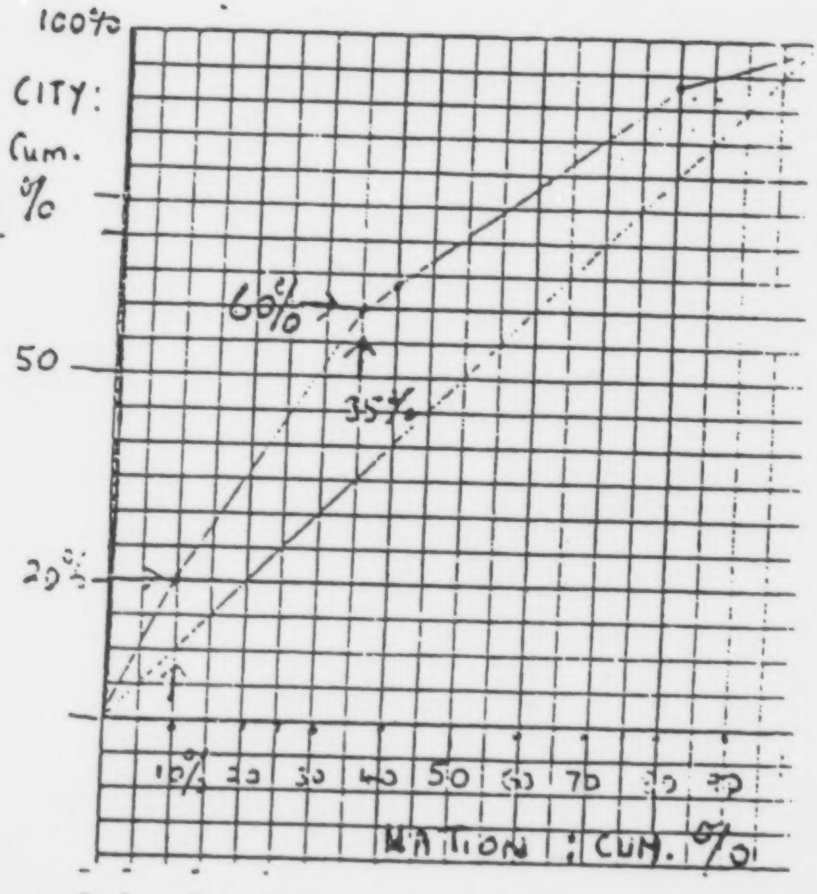
Calculations:

$C_i \cdot D_{i+1}$	$D_i \cdot C_{i+1}$	Absolute Difference
20 x 35 = 700	10 x 60 = 600	+100
60 x 40 = 2400	35 x 64 = 2240	+160
64 x 80 = 5120	40 x 94 = 3760	+1360
94 x 100 = 9400	80 x 100 = 8000	+1400
	Total	+3020

$$G = \frac{3020}{10000} = 0.302$$

ts

lel



Calculations

Table 3-2

Gini Coefficients and Local Specializations

Grade.	No.	Place	Specialization (Gini Coeff)	Highly Specialized Activities in Centres Index Local Specializ.> 2.0 Forestry	Mines	Manuf.	Transp.	Other
I	1	Edmonton	0.22 (0.23)*					
	2	Calgary	0.24 (0.29)					
II	3	Lethbridge	0.22 (0.23)	-				
	4	Red Deer	0.22 (0.25)	-				
	5	Medicine Hat	0.20 (0.20)	-				
	6	Grande Prairie	0.18 (0.21)	5.1				
III	7	Sherwood Park	Not Available	-				
	8	St. Albert	0.18 (0.20)	-				
	9	Ft. McMurray	0.50 (0.54)	-	8.1			
	10	Lloydminster	0.23 (0.27)	-				
	11	Camrose	0.23 (0.25)	-	-			
	12	Brooks	0.20 (0.24)	-	2.3			
	13	Edson	0.24 (0.34)	9.1	-			
	14	Rocky Mtn. House	0.34 (0.39)	9.2	3.7			
	15	Whitecourt	0.35 (0.41)	3.7	4.8			
	16	Drayton Valley	0.48 (0.52)	-	7.1			
	17	Peace River	0.26 (0.27)	-	-			
	18	Hinton	0.39 (0.42)	9.9	2.2	3.1		
	19	Wetaskiwin	0.26 (0.28)	-				
	20	Stettler	0.26 (0.30)	-				
	21	Westlock	0.28 (0.31)	-				
	22	Drumheller	0.24 (0.26)	-				
	23	Taber	0.22 (0.25)	-				
	24	Leduc	0.21 (0.26)	-				
	25	Ft. Saskatchewan	0.37 (0.39)	-		3.8		
	26	Spruce Grove	0.21 (0.25)	-				
	27	Banff	0.46 (0.48)	-				Pers. S 2.2
IV	28	St. Paul	0.28	-				
	29	High River	0.20	-				
	30	Cardston	0.18	-				
	31	Athabasca	0.23	4.1				
	32	Bonnyville	0.32	-	-	-	-	Unspec. 2.5

Table 3-2

Gini Coefficients and Local Specializations

Grade	No.	Place	Specialization (Gini Coeff)	Highly Specialized Activities in Centres Index Local Specializ. > 2.0 Forestry	Mines	Manuf.	Transp.	Other
	33	Ponoka	0.31	-				
	34	Olds	0.26	-	-	-	-	Agric. 2.3
	35	Vegreville	0.30	-				
	36	Wainwright	0.35	-	-	-	-	Gov't/Defence 3.0
	37	Vermilion	0.25	-				
	38	Ft. Macleod	0.29	-				
	39	Grand Centre	0.51	-	-	-	-	Gov't/Defence 5.3
	40	Slave Lake	0.36	7.1	3.3			
	41	Valleyview	0.38	-	3.4			
	42	Barrhead	0.25	2.9	-			
	43	Innisfail	0.24	-				
	44	Claresholm	0.32	-				
	45	Lacombe	0.20	-				
	46	Stony Plain	0.26	-				
	47	Pincher Creek	0.38	-	4.7			
	48	Hanna	0.31	-	-	-	2.5	
	49	High Prairie	0.22	3.4	-			
	50	Fairview	0.25	-				
	51	Jasper	0.43	-			3.6	
	52	Canmore	0.40	2.2	5.3			
V	53	Blairmore	0.34	4.5	4.7			
	54	Coaldale	0.23	-		2.0		
	55	Redwater	0.26	-	2.1	3.4		
	56	Didsbury	0.38	-	3.7			
	57	Nanton	0.24	-				
	58	Raymond	0.21	-				
	59	Carstairs	0.51	-				
	60	Grande Cache	0.60	3.1	12.2			
	61	Redcliff	0.35	-	4.0			
	62	Devon	0.32	-	2.2			
	63	Strathmore	0.17	-	-			
	64	Airdrie	0.22	-	-			
	65	Lac La Biche	0.32	4.8	-			
	66	Morinville	0.25	-	-			
	67	Rimbey	0.26	3.3	2.0			

Table 3-2

Gini Coefficients and Local Specializations

Grade	No.	Place	Specialization (Gini Coeff)	Highly Specialized Activities in Centres Index Local Specializ.> 2.0				
				Forestry	Mines	Manuf.	Transp.	Other
	68	Cochrane	0.46	-	-			Pers. S. 2.0
	69	Okotoks	0.21	-	-			
	70	Sylvan Lake	0.34	-	2.2	-	-	Construction 2.1
	71	Nisku	Not Available	-	-			
	72	Namao	Not Available	-	-			
	73	High Level	0.28	10.7	2.1			
	74	Sundre	0.27	-	2.2			
	75	Fox Creek	0.74	-	13.7	-	-	Unspec. 2.2
	76	Coronation	0.24	-	-			
	77	Swan Hills	0.65	-	11.0			
	78	Vulcan	0.20	-	-			
	79	Provost	0.22	-	-			
	80	Three Hills	0.27	-	-			
	81	Crossfield	0.29	-	4.1	-	2.7	Unspec. 2.0
	82	Bassano	Not Available	-	-			
	83	Tofield	0.27	-	-			
	84	Bow Island	0.21	-	-			
	85	Eckville	0.38	-	-			
	86	Manning	0.39	-	4.7			Unspec. 2.5
	87	Grimshaw	0.32	-	-			
	88	Vauxhall	0.31	-	-	2.2		
VI	89	Viking	0.36	-	-	-	-	Transport. 2.1
	90	Oyen	0.39	-	-			Unspec. 2.0 Trade 2.1
	91	Killam	0.24	-	-			Finance 2.1
	92	Bashaw	0.20	-	-			
	93	Castor	0.23	-	-			
	94	Falher	0.23	-	-	-	-	Finance 2.8
	95	Milk River	0.26	-	-			
	96	Picture Butte	0.27	-		2.3		
	97	Beaverlodge	0.35	-				
	98	Forestburg	0.32	-				
	99	Thorsby	Not Available	-				
	100	Bentley	Not Available	-				
	101	Legal	Not Available	-				
	102	Onoway	Not Available	-				
	103	Sangudo	Not Available	-				

Table 3-2

Gini Coefficients and Local Specializations

Grade	No.	Place	Specialization (Gini Coeff)	Highly Specialized Activities in Centres Index Local Specializ. > 2.0				
				Forestry	Mines	Manuf.	Transp.	Other
	104	Lamont	0.36	-				
	105	Two Hills	0.27	-				
	106	Alix	Not Available	-				
	107	Elk Point	0.36	-				Trade 2.0
	108	Coleman	0.53	10.4	8.4			
	109	Spirit River	0.21	9.9				
	110	Mayerthorpe	0.25	-				
	111	Smoky Lake	0.29	-				
	112	Trochu	0.36	-				Unspec. 2.1
	113	Daysland	Not Available	-				
	114	Consort	0.39	-				Unspec. 2.0
	115	Evansburg	Not Available	-				
	116	Sedgewick	0.18	-				
	117	Mundare	Not Available	-				

III. EMPIRICAL RESULTS

Table 3-2 shows the Gini coefficient calculations for the 104 Alberta centres. Table 3-3 shows the breakdown by size class.

Table 3-3

Gini Coefficients: Size Distribution

<.15	.15 to .19	.20 to .24	.25 to .29	.30 to .34	.35 to .39	.40 to .44	.45 to .49	.50 to .54	.55 to .59	>.60
0	6	31	23	13	18	3	3	4	0	3

A coefficient of 1.0 indicates complete specialization for the economic profile of a town, whereas, 0.0 is complete diversification. Since Table 3-3 shows that half the centres have coefficients in the 0.20 to 0.29 range, it is apparent that Alberta towns have very low degrees of specialization; their industrial structures as measured by employment figures are very diversified. Very similar values are produced when the Prairie rather than the Alberta totals are used as the base measure. There are, of course, some exceptions as Table 3-2 shows. Thus of the places with Gini values greater than 0.4 various economic specializations can be identified.

Mining and Oils - Ft. McMurray, Drayton Valley, Carstairs, Grande Cache, Fox Creek, Swan Hills, Canmore (and Forestry), Coleman (and Forestry).

Personal Services - Banff, Cochrane

Government and Defence - Grande Centre, Wainwright

Transport - Jasper

Some authorities have maintained that there is a positive relationship between city size and the degree of economic diversification - in other words, as size increases so the Gini coefficient or degree of diversification increases (Crowley, 1971, 1973; Clemente and Sturgis, 1971; Paraskevopoulos, 1975). Although the largest centres in Alberta have very low levels of diversification

Table 3-2 shows that many small centres have the same values. Indeed, the correlation between Size and Gini Coefficient was only -0.12, a value that was not insignificant. Even if the log values are used the relationship does not improve although it rises to -0.20. These results confirm that there is no evidence in Alberta for the thesis that increased city size is linked to greater economic diversification. Similarly, it could be postulated that there is a relationship between diversification and population change, in the sense that the economically more diversified places weather the inevitable recessions associated with particular industries. The correlation study showed that there is no significant association between diversified towns and increased growth in Alberta: Correlations between Gini coefficient and Absolute Population Change 1961 - 1971 was -0.11 (log. -0.11) and +0.05 (log. -0.01) with Percentage Change 1961 - 1971.

A. Industrial Specialization in the Centres in 1971

Table 3-2 lists the location quotients or indices of local specialization for all the centres in the analysis. A value >1.0 indicates that the industry has a greater specialization than for the province as a whole. It must be emphasized that the tables need to be interpreted with care since the eleven categories of industry for which employment figures are available are quite gross groups (Table 3-1). For example, the Mines and Oil category includes all people working in the mining or oil industry, whether coal or oil and gas or head office personnel or workers in the mine or field. Similarly, the Government/Defence category encompasses all government employees whether federal or provincial and members of the armed services. Yet despite this cautionary note these two examples provide a quantitative measurement of the way the two activities are quite differently associated with Calgary and Edmonton. Thus the Index of Local Specialization or The Location Quotient for Mines and Oils is 1.74 in Calgary compared to 0.48 for Edmonton whereas the Government/Defence Index is 0.82 for Calgary and 1.38 for Edmonton. Such divergence should not, however, be exaggerated. For the other industrial categories the figures for Calgary and Edmonton are very, very similar, illustrating the parallel these two metropolitan centres play in the economy of northern and southern Alberta respectively. A somewhat similar conclusion must be reached for the four regional centres: Lethbridge, Red Deer, Medicine Hat and Grande Prairie, and the Mines/Oil category shows a variety of low values, whilst the high quotient of 5.13 for the Forestry/Trapping category in Grande Prairie gives the centre a distinctive economic speciality. But most of the other values are quite similar although the limited trade area of Medicine Hat (Chapter 2 Section IV) would appear to be responsible for the low quotient for Finance.

Table 3-2 shows that there are quite big differences between the degree of localization of particular industries. There seems little point in dealing in detail with the Agriculture value since this is obviously a non-urban activity yet five places have scores greater than 1.0 primarily due to the fact the Enumeration areas include part of the area around the service centre although in the case of Olds the presence of the Agriculture College ensures that people working in the college are classified as agricultural, thereby giving a high score to the centre. Similarly there is little to be gained in dealing with the Unspecified category since this is the error term or "catch all" category.

For the Forestry industry only 25 places have scores over 1.0 but nine are above 5.0, illustrating the extreme centralization of the activity in a limited number of towns. Table 3-2 confirms that the majority of these centres are in the north and west but provides a measurement of the degree of localization. Hency Rocky Mountain House (9.2), Spirit River (10.3), High Level (10.7), Slave Lake (7.1) have the highest values although the presence of Coleman (10.3) in this set of highly specialized towns must also be noted.

The 41 places with quotients greater than 1.0 for the Mines/Oil Industry demonstrates that this activity has a widespread distribution in the prairie, in the north and west, although with similar levels of concentration in certain centres: Ft. McMurray (8.1), Drayton Valley (7.1), Fox Creek (13.7), Swan Hills (11.0), Grande Cache (12.1), Canmore (5.3), Coleman (8.4) represent the places with scores >5.0. Of the larger service centres only Calgary has a quotient greater than 1.0. Obviously it is not as high as in the smaller centres since the greater size of Calgary's employed population evens out the effects of this activity. In addition many other people are employed in linked or service activities rather than directly in the oil/mines industry.

The recent government commitments to expanding the manufacturing base of the Alberta economy is not a surprising response given the high degree of localization of the industry in the Province in 1971. Only 27 towns have quotients for Manufacturing greater than 1.0, which is a similar degree of localization as is the forestry industry! Apart from Devon (2.1) and Hinton (3.1) the places with highest degrees of specialization are located in the vicinity of the largest centres, in other words they are, in most cases, industrial satellites, namely: Picture Butte (2.3), Vauxhall (2.2), Coaldale (2.0), Redcliffe (3.9), Redwater (2.3), Ft. Saskatchewan (3.8). It is worth re-emphasizing that all the metropolitan and regional capitals except Red Deer have higher degrees of specialization than the provincial totals.

In contrast to all the previous activities the Construction industry is more widely scattered for 53 of the centres have quotients greater than 1.0. This element of dispersion is also refelcted in the fact that there are very few high levels of concentration; Sylvan Lake is the only centre, with the largest centres, to have high levels of concentration. Indeed one third of the Groups I, II, III and IV centre from the commercial hierarchy analysis have location quotients greater than 1.0. Perhaps worthy of note is the fact that Red Deer, Medicine Hat and marginally Lethbridge have quotients less than 1.0. It is worth re-emphasizing the fact that these figures relate to 1971. Since that data it is obvious that many of these regional centres have grown rapidly and added more people to their construction industry.

A quite widespread distribution also characterizes the Transport Industry, where 45 places have quotients greater than 1.0. Five places attain values over 2.0, namely Hanna (2.5), Carstairs (2.7), Viking (2.1), Forestburg (2.5) with Jasper (3.6) achieving the highest value by reason of its continuing role as a railroad centre. It is not without significance that all the centres with the highest level of specialization are small towns in which the addition of quite limited numbers of workers in any specialized industry can have a dramatic effect on the location quotient involved.

It would be trite to find the concentration of Trade in urban places at all surprising. Four-fifths of the 104 centres have location quotients higher than 1.0, including practically all the places in Groups I to IV, the larger places in the province. On this occasion it makes more sense to focus on the centres that fail to achieve quotients greater than 1.0. Table 3-2 shows that the majority are the centres previously categorized as norther resource towns, specialized in Forestry or Mines and Oil. Hence, centres such as Ft. McMurray (0.57), and Grande Cache (0.46), Fox Creek (0.24) stand out as being centres with much lower levels of service activity than their total employment size would imply.

The Personal Services economic category has a very similar pattern to the trade category in that 81 out of the 104 places have location quotients greater than 1.00. Again few high concentrations can be found, since Banff (2.2) with its tourist industry associations, and Cochrane (2.1) with its reputation as a dormitory for Calgary, are the only centres with quotients greater than 2.0. Most centres with low values are again the resource towns of the north and west.

For the Finance industry only half of the centres have quotients greater than 1.0. Most of the largest places have higher values although there are very few centres with high specialization. Apart from the two small centres of Killam (2.0) and Falher (2.76) where minor concentrations have a high impact, given the small size of the total labour force, it is noteworthy that Calgary with 1.6 had the highest specialization in this category in 1971 - even before the Arab oil embargo led to the surplus in oil related companies.

Finally, the Government-Defence category is as geographically concentrated as some of the natural resource industries. A total of 35 centres have quotients greater than 1.0 but only Grande Centre (5.2), Wainwright (3.0) and Beaverlodge (2.9) have values above 2.0. Obviously all these places are near Armed Forces bases demonstrating that it it the defence component of the category that creates the high levels of localization associated with this activity.

APPENDIX A

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ECON BASE ANALYSIS:      ALTA. CENTRES.(1971)

INPUT DATA

                  AGRICULT.  FORESTRY MINES/OIL MANUFACT.   CONSTP.  TRANSPORT     TRADE   FINANCE   PERSONAL GOVIT/DEF.   UNSPEC.
11  CALGARY          950.00     40.00  10995.00  19670.00  15280.00  15390.00  30270.00   9715.00   49070.00  10605.00   1635.00
12  EDMONTON        3295.00    200.00   3675.00  24615.00  17300.00  19960.00  37415.00   9485.00   59070.00  21445.00   1765.00
13  LETHBRIDGE       440.00      0.00     40.00   2515.00   1320.00   1520.00   3625.00    725.00    5605.00   1440.00   1010.00
14  RED DEER          80.00      0.00    435.00    900.00    715.00    880.00   2180.00    455.00    4065.00    970.00    740.00
15  MED.HAT          430.00      0.00    130.00   1580.00    545.00   1100.00   1765.00    270.00    2765.00    865.00    630.00
16  GRD PRAR.         80.00     90.00    105.00    575.00    520.00    515.00   1150.00    715.00    1540.00    570.00    490.00
17  SHERD PK            N/A      0.00      0.00      0.00      0.00      0.00      0.00      0.00       0.00      0.00      0.00
18  ST.ALB            60.00      0.00    120.00    510.00    350.00    470.00    820.00    220.00    1735.00    460.00    245.00
19  FT.MCCMUR.        20.00     15.00    805.00     50.00    260.00    155.00    220.00     60.00     525.00    105.00    325.00
20  LLOYDMIN          75.00      0.00    245.00    340.00    270.00    370.00    790.00    110.00     565.00    140.00    210.00
21  CAMROSE          120.00      0.00     50.00    280.00    210.00    285.00    700.00    160.00    1195.00    175.00    275.00
22  BROOKS            85.00      0.00    165.00     85.00    165.00    190.00    315.00     75.00     475.00    120.00    145.00
23  EDSON             10.00     45.00    125.00     40.00    190.00    185.00    300.00     50.00     475.00    125.00    105.00
24  ROCKY M.H         20.00     35.00    180.00     50.00    140.00     90.00    250.00     55.00     270.00     55.00    115.00
25  WHITECRT           0.00     15.00    250.00    100.00    165.00    105.00    200.00     30.00     335.00     40.00    115.00
26  DRAYTON V          0.00      0.00    385.00     15.00    160.00    135.00    260.00     35.00     330.00     30.00    100.00
27  PEACE R.          40.00     35.00     35.00    110.00    150.00    165.00    410.00     95.00     630.00    270.00    205.00
28  HINTON             0.00     55.00    160.00    520.00    150.00    150.00    235.00     30.00     360.00     75.00    115.00
29  WETASK.           55.00      5.00     55.00    190.00    135.00    140.00    615.00     90.00     605.00    145.00    120.00
30  STETTLER          85.00      0.00     90.00     85.00    150.00     95.00    505.00     45.00     540.00     90.00    115.00
31  WESTLOCK          45.00      0.00     10.00     45.00     55.00    100.00    270.00     65.00     470.00     60.00     70.00
32  DRUMHEL.          70.00      5.00     60.00     45.00    115.00    160.00    370.00     40.00     515.00    250.00    130.00
33  TABER             85.00      5.00     75.00    295.00    130.00     90.00    425.00     80.00     465.00     95.00    130.00
34  LEDUC             45.00      0.00     90.00     85.00    140.00    230.00    245.00     65.00     465.00    105.00    140.00
35  FT.SASK           40.00     10.00     80.00    755.00    120.00    135.00    215.00     65.00     440.00    235.00    120.00
36  SPRUCE GR         25.00      0.00     60.00    105.00    140.00    115.00    225.00     50.00     255.00     60.00     60.00
37  BANFF              0.00      0.00      0.00      5.00     30.00    165.00    265.00     30.00    1060.00    225.00    210.00
38  ST.PAUL           15.00      5.00      0.00     50.00    125.00    100.00    260.00     80.00     525.00    140.00    165.00
39  HIGH RIV          85.00      0.00     35.00    110.00     85.00     85.00    325.00     65.00     400.00     95.00    175.00
40  CARDSTON         100.00      5.00     15.00     35.00     70.00     65.00    215.00     30.00     320.00    110.00    160.00
41  ATHABASCA         20.00     10.00     15.00     50.00     65.00     55.00    180.00     30.00     260.00     60.00     75.00
42  BONNYVIL.         15.00     10.00     15.00     15.00     45.00     60.00    160.00     30.00     230.00     90.00    165.00
43  PONOKA            50.00      0.00     40.00     70.00    155.00     75.00    335.00    100.00     640.00    125.00    160.00
44  OLDS             345.00      0.00     25.00     55.00     45.00     85.00    135.00     40.00     235.00     45.00     50.00
45  VEGREV.           55.00      0.00      5.00     25.00    160.00    100.00    305.00     25.00     365.00     90.00    155.00
46  WAINWRIT          45.00      0.00     40.00     20.00    110.00     65.00    290.00     15.00     375.00    375.00    160.00
47  VERMILION         45.00      0.00      5.00     60.00     50.00     50.00    245.00     35.00     340.00    135.00     75.00
48  FT.MACLEOD        25.00      5.00      0.00    180.00     60.00     70.00    190.00     10.00     310.00     55.00    105.00
49  GRND CENTR         5.00      0.00      5.00     25.00     45.00     65.00    165.00     40.00     145.00    400.00     95.00
50  SLAVE L            0.00     15.00     90.00     20.00     25.00     80.00 [illegible]   10.00     165.00     75.00     50.00
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51	VALLEYVW	10.00	0.00	90.00	10.00	70.00	70.00	80.00	15.00	265.00	25.00	60.00
52	BARRHID	40.00	10.00	30.00	45.00	70.00	55.00	255.00	60.00	395.00	80.00	115.00
53	INNISFIL	30.00	0.00	30.00	75.00	50.00	25.00	215.00	40.00	265.00	85.00	55.00
54	CLARESHM	50.00	0.00	15.00	155.00	25.00	50.00	265.00	5.00	455.00	55.00	55.00
55	LACOMBE	130.00	0.00	30.00	40.00	125.00	60.00	155.00	60.00	435.00	80.00	105.00
56	STONY PL.	35.00	0.00	5.00	15.00	70.00	35.00	135.00	5.00	165.00	55.00	50.00
57	PINCHER CR	20.00	0.00	245.00	40.00	155.00	70.00	240.00	45.00	370.00	65.00	70.00
58	HANNA	20.00	0.00	25.00	40.00	60.00	220.00	240.00	50.00	285.00	70.00	60.00
59	HI PRAIRE	25.00	10.00	20.00	65.00	40.00	80.00	150.00	50.00	335.00	110.00	60.00
60	FAIRVIEW	50.00	0.00	15.00	45.00	35.00	50.00	145.00	35.00	320.00	60.00	30.00
61	JASPER	10.00	0.00	5.00	35.00	65.00	435.00	190.00	55.00	480.00	160.00	75.00
62	CANMORE	0.00	5.00	155.00	55.00	40.00	25.00	160.00	15.00	265.00	65.00	25.00
63	BLAIRMRE	0.00	10.00	135.00	70.00	50.00	55.00	90.00	0.00	145.00	55.00	60.00
64	COALDALE	80.00	0.00	5.00	215.00	130.00	65.00	195.00	35.00	310.00	55.00	90.00
65	REDWATER	40.00	0.00	45.00	120.00	60.00	45.00	55.00	20.00	95.00	35.00	40.00
66	DIDSBURY	0.00	0.00	90.00	45.00	30.00	35.00	135.00	10.00	225.00	40.00	15.00
67	NANTON	50.00	0.00	5.00	5.00	20.00	40.00	105.00	20.00	110.00	20.00	40.00
68	RAYMOND	90.00	0.00	0.00	85.00	45.00	20.00	130.00	20.00	170.00	25.00	75.00
69	CARSTAIRS	5.00	0.00	40.00	0.00	35.00	55.00	50.00	10.00	40.00	0.00	20.00
70	GRND CACHE	5.00	10.00	510.00	20.00	65.00	35.00	75.00	15.00	215.00	40.00	95.00
71	REDCLIFF	55.00	0.00	20.00	330.00	60.00	45.00	130.00	15.00	155.00	55.00	80.00
72	DEVON	5.00	0.00	45.00	105.00	65.00	35.00	75.00	15.00	135.00	30.00	20.00
73	STRATHMRE	45.00	0.00	5.00	30.00	50.00	40.00	90.00	15.00	135.00	30.00	25.00
74	AIRDRIE	30.00	0.00	10.00	45.00	60.00	50.00	100.00	15.00	90.00	20.00	25.00
75	LAC LA B	20.00	10.00	35.00	10.00	45.00	40.00	90.00	20.00	300.00	70.00	50.00
76	MORINVLE	15.00	0.00	20.00	70.00	50.00	25.00	90.00	15.00	90.00	35.00	60.00
77	RIMBEY	15.00	5.00	40.00	20.00	50.00	35.00	110.00	5.00	140.00	35.00	55.00
78	COCHRANE	0.00	0.00	0.00	0.00	10.00	30.00	80.00	10.00	260.00	50.00	60.00
79	OKOTOKS	70.00	0.00	20.00	35.00	50.00	40.00	180.00	40.00	155.00	30.00	80.00
80	SYLVAN L	10.00	0.00	45.00	25.00	85.00	45.00	70.00	20.00	160.00	10.00	30.00
81	NISKU	N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
82	NAMAO	N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
83	HIGH LEVEL	5.00	20.00	50.00	60.00	65.00	80.00	110.00	20.00	110.00	50.00	55.00
84	SUNDRE	5.00	0.00	40.00	25.00	45.00	35.00	55.00	10.00	70.00	25.00	30.00
85	FOX CREEK	0.00	0.00	215.00	0.00	40.00	15.00	15.00	5.00	35.00	15.00	65.00
86	CORONATIN	15.00	0.00	15.00	10.00	45.00	35.00	75.00	15.00	130.00	20.00	50.00
87	SWAN H	0.00	0.00	230.00	0.00	55.00	50.00	50.00	0.00	90.00	0.00	55.00
88	VULCAN	50.00	0.00	15.00	15.00	60.00	40.00	105.00	5.00	170.00	55.00	75.00
89	PROVOST	45.00	0.00	15.00	35.00	50.00	45.00	170.00	15.00	165.00	30.00	55.00
90	3HILLS	25.00	0.00	10.00	50.00	90.00	40.00	145.00	35.00	315.00	95.00	30.00
91	CROSSFIELD	10.00	0.00	10.00	10.00	10.00	30.00	50.00	5.00	60.00	10.00	35.00
92	BASSANO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00
93	TOFIELD	10.00	0.00	5.00	15.00	20.00	50.00	65.00	15.00	130.00	25.00	40.00
94	BOW IS.	90.00	0.00	0.00	25.00	45.00	40.00	95.00	20.00	100.00	35.00	70.00
95	ECKVILLE	0.00	0.00	20.00	10.00	10.00	15.00	65.00	5.00	90.00	5.00	20.00
96	MANNING	0.00	5.00	0.00	10.00	20.00	25.00	80.00	10.00	125.00	15.00	65.00
97	GRIMSHAW	15.00	0.00	10.00	10.00	75.00	95.00	170.00	25.00	150.00	75.00	45.00
98	VAUXHALL	15.00	0.00	0.00	70.00	35.00	25.00	70.00	5.00	75.00	45.00	10.00
99	VIKING	30.00	0.00	5.00	15.00	20.00	75.00	80.00	0.00	185.00	10.00	25.00
100	OYEN	25.00	0.00	0.00	0.00	10.00	10.00	105.00	5.00	110.00	20.00	50.00
101	KILLAM	20.00	0.00	10.00	15.00	15.00	20.00	50.00	25.00	115.00	15.00	35.00
102	BASHAW	25.00	0.00	15.00	20.00	15.00	30.00	85.00	15.00	90.00	15.00	25.00
103	CASTOR	30.00	0.00	30.00	15.00	55.00	25.00	75.00	15.00	165.00	45.00	30.00
104	FALHER	45.00	0.00	10.00	0.00	35.00	25.00	65.00	35.00	95.00	20.00	20.00
105	MILK RIVER	45.00	0.00	5.00	15.00	10.00	10.00	80.00	15.00	65.00	10.00	25.00
106	PIC BUTTE	35.00	0.00	0.00	105.00	35.00	30.00	100.00	20.00	130.00	25.00	20.00
107	BEAVERLGE	20.00	0.00	5.00	30.00	10.00	25.00	90.00	15.00	175.00	125.00	45.00
108	FORESTBURG	15.00	0.00	15.00	10.00	10.00	50.00	45.00	5.00	55.00	10.00	40.00
109	THORSBY		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
110	BENTLEY		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
111	LEGAL		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

112	UNDWAY	N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00
113	SANGUDO	N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00
114	LAMONT	15.00	0.00	0.00	35.00	20.00	10.00	30.00	0.00	125.00	15.00	50.00
115	2HILLS	10.00	0.00	0.00	50.00	30.00	15.00	75.00	0.00	105.00	35.00	45.00
116	ALIX	N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
117	ELK P,T	10.00	0.00	15.00	0.00	10.00	20.00	85.00	5.00	95.00	10.00	30.00
118	COLEMAN	0.00	20.00	210.00	90.00	15.00	50.00	65.00	5.00	115.00	20.00	55.00
119	SPIRIT RIV	35.00	15.00	10.00	15.00	45.00	40.00	85.00	20.00	130.00	40.00	60.00
120	MAYERTHIE	40.00	0.00	60.00	20.00	120.00	80.00	240.00	40.00	260.00	60.00	80.00
121	SMOKY LK.	5.00	0.00	5.00	5.00	20.00	35.00	50.00	15.00	120.00	35.00	40.00
122	TROCHU	15.00	0.00	5.00	5.00	5.00	20.00	65.00	20.00	105.00	5.00	45.00
123	DAYSLAND	N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
124	CONSORT	10.00	0.00	20.00	5.00	15.00	15.00	45.00	10.00	110.00	0.00	40.00
125	EVANSBURG		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
126	SEDGEWICK	15.00	0.00	10.00	20.00	15.00	10.00	45.00	10.00	80.00	25.00	15.00
127	MUNDARE	N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
128	BLACK DID	15.00	10.00	45.00	20.00	55.00	15.00	45.00	0.00	45.00	20.00	25.00
129	BELLEVUE	0.00	15.00	90.00	70.00	20.00	25.00	40.00	15.00	65.00	5.00	75.00
130	MAGRATH	30.00	0.00	0.00	55.00	15.00	15.00	75.00	5.00	75.00	20.00	45.00
131	COLD LAKE	0.00	0.00	0.00	15.00	15.00	25.00	45.00	15.00	135.00	200.00	45.00
132	MCCLENNAN	5.00	5.00	5.00	15.00	50.00	70.00	25.00	15.00	135.00	30.00	25.00
133	BLACKFALDS	10.00	0.00	20.00	20.00	35.00	40.00	60.00	5.00	65.00	5.00	20.00
134	CALMAR	5.00	0.00	30.00	20.00	60.00	35.00	30.00	0.00	65.00	20.00	25.00
135	MANNVILLE	15.00	0.00	0.00	5.00	25.00	15.00	45.00	10.00	50.00	20.00	25.00

APPENDIX B

ECON BASE ANALYSIS: ALTA. CENTRES.(1971)

LOCATION QUOTIENTS

		AGRICULT.	FORESTRY	MINES/OIL	MANUFACT	CONSTR.	TRANSPORT	TRADE	FINANCE	PERSONAL	GOV'T/DEF	UNSPEC.
11	CALGARY	.05	.08	1.74	1.33	1.23	1.19	1.22	1.62	1.22	.82	.13
12	EDMONTON	.13	.34	.48	1.37	1.15	1.27	1.25	1.30	1.22	1.38	.12
13	LETHBRIDGE	.20	0.00	.06	1.57	.98	1.09	1.36	1.12	1.16	1.04	.77
14	RED DEER	.06	0.00	.99	.87	.82	.98	1.26	1.08	1.45	1.08	.87
15	MED.HAT	.33	0.00	.33	1.69	.70	1.35	1.13	.72	1.10	1.07	1.08
16	GRD PRAR.	.11	5.13	.46	1.08	1.17	1.11	1.30	1.00	1.08	1.24	1.12
17	SHERD PK	N/A										
18	ST.ALB	.11	0.00	.69	1.24	1.13	1.31	1.20	1.32	1.11	1.29	.73
19	FT.MCCMUR.	.06	1.95	8.14	.22	1.44	.76	.57	.64	.84	.52	1.70
20	LLOYDIN	.17	0.00	1.82	1.08	1.82	1.16	1.53	.85	1.15	.51	.81
21	CAMROSE	.27	0.00	.37	.88	.79	1.02	1.43	1.24	1.39	.63	1.05
22	BROOKS	.37	0.00	2.33	.51	1.33	1.24	1.14	1.12	1.06	.83	1.05
23	EDSON	.05	9.09	1.96	.27	1.51	1.41	1.20	.83	1.18	.96	.85
24	ROCKY M.H	.12	9.18	3.67	.43	1.45	.89	1.35	1.18	.87	.55	1.22
25	WHITECIT	0.00	3.69	4.77	.81	1.60	.98	.97	.60	1.01	.38	1.14
26	DRAYTON V	0.00	0.00	7.09	.12	1.48	1.21	.94	.59	.96	.27	.96
27	PEACE R.	.14	5.02	.39	.52	.85	1.87	1.16	1.11	1.11	1.48	1.16
28	HINTON	0.00	9.91	2.24	3.10	1.06	1.02	.84	.44	.79	.52	.83
29	WETASK.	.18	.70	.60	.88	.75	.95	1.71	1.03	1.38	.78	.68
30	STETTLER	.37	0.00	1.29	.52	1.09	.67	1.65	.68	1.23	.64	.86
31	WESTLOCK	.30	0.00	.21	.41	1.03	1.04	1.47	1.01	1.59	.63	.76
32	DRUMHEL.	.32	.95	.88	.26	.86	1.15	1.39	.62	1.19	1.81	.99
33	TABER	.36	.89	1.03	1.73	.91	.61	1.50	1.16	1.01	.64	.93
34	LEDUC	.22	0.00	1.45	.58	1.14	1.85	1.30	1.10	1.18	.83	1.17
35	FT.SASK	.14	1.50	.93	3.76	.71	.77	.64	.90	.81	1.35	.73
36	SPRUCE GR	.18	0.00	1.39	1.04	1.65	1.30	1.33	1.22	.93	.91	.72
37	BANFF	0.00	0.00	0.00	.03	.20	1.05	.88	.41	2.18	1.44	1.42
38	ST.PAUL	.08	1.15	0.00	.38	1.14	.87	1.19	1.13	1.46	1.23	1.53
39	HIGH RIV.	.46	0.00	.62	.83	.72	.74	1.47	1.22	1.12	.83	1.62
40	CARDSTON	.75	1.56	.36	.36	.86	.77	1.33	.77	1.23	1.31	1.26
41	ATHABASCA	.19	4.09	.48	.68	.97	.85	1.46	1.00	1.30	.94	1.24
42	BONNYVIL.	.13	3.77	.44	.19	1.41	.80	1.19	.92	1.06	1.29	2.50
43	PONOKA	.21	0.00	.54	.40	1.06	.49	1.69	1.42	1.79	.63	1.12
44	OLDS	2.26	0.00	.53	.50	1.03	.83	.57	.90	1.11	.69	.55
45	VEGREV.	.33	0.00	.10	.21	1.00	1.82	1.53	.52	1.13	.87	1.58
46	WAINWRIT	.26	0.00	.76	.16	1.07	.61	1.27	.90	1.13	3.05	.99
47	VERMILION	.31	0.00	.11	.58	1.04	.76	1.42	.84	1.40	1.51	.88
48	FT.MACLEOD	.20	1.65	0.00	1.96	.78	.89	1.24	.77	1.75	.69	1.40
49	GRND CENTR	.04	0.00	.13	.29	.61	.59	.75	1.13	.83	5.27	1.32
50	SLAVE L	0.00	7.14	3.33	.31	1.59	1.44	[illegible]	[illegible]	1.05	1.36	1.15

THE UNIVERSITY OF CALGARY

51	VALLEYIW	.11	0.00	3.35	.16	1.32	1.27	.70	.59	1.56	.40	1.16
52	BARRHID	.27	2.86	.67	.43	.80	.61	1.46	1.47	1.40	.68	1.34
53	INNISFIL	.27	0.00	.89	.95	.75	.36	1.63	1.75	1.24	1.24	.85
54	CLARESIM	.35	0.00	.34	1.51	.70	.56	1.59	.12	1.64	.62	.65
55	LACOMBE	.84	0.00	.63	.36	1.33	.67	.44	.49	1.44	.63	1.15
56	STONY PL.	.46	0.00	.22	.28	1.53	.74	1.41	.23	1.26	1.36	1.12
57	PINCHER CR	.12	0.00	4.66	.32	1.50	.65	1.36	.93	1.11	.61	.59
58	HANNA	.14	0.00	.59	.40	.95	2.51	1.43	1.23	1.03	.81	.97
59	HI PRAIRE	.20	3.38	.53	.95	.53	1.02	1.01	1.38	1.39	1.42	1.09
60	FAIRVIEW	.51	0.00	.49	.63	.59	.80	1.22	1.21	1.66	.97	.51
61	JASPER	.05	0.00	.39	.25	.73	3.61	.78	.99	1.29	1.34	.66
62	CANMORE	0.00	2.22	5.35	.81	.70	.42	1.41	.54	1.12	1.19	.45
63	BLAIRMIE	0.00	4.50	4.72	1.04	.90	.94	.80	0.00	1.08	.44	1.45
64	COALDALE	.54	0.00	.11	2.01	1.45	.69	1.09	.81	1.07	.59	1.02
65	REDWATER	.57	0.00	2.10	2.38	1.42	1.02	.65	.38	.70	.80	.97
66	DIDSBURY	0.00	0.00	3.73	.79	.53	.71	1.43	.44	1.47	.81	.32
67	NANTON	.96	0.00	.31	.13	.63	1.22	1.67	1.31	1.08	.61	1.29
68	RAYMOND	1.08	0.00	0.00	1.42	.89	.36	1.30	.83	1.05	.48	1.53
69	CARSTAIRS	.16	0.00	4.06	0.00	1.90	2.72	1.29	1.07	.64	0.00	1.05
70	GRND CACHE	.04	3.07	12.16	.20	.79	.41	.46	.38	.61	.47	1.18
71	REDCLIFF	.48	0.00	.57	3.98	.86	.62	.72	.45	.69	.76	1.17
72	DEVON	.07	0.00	2.20	2.18	1.41	.63	.93	.77	1.64	.72	.51
73	STRATHIE	.74	0.00	.27	.68	1.35	1.56	1.23	.84	1.14	.79	.69
74	AIRDRIE	.53	0.00	.58	1.11	1.77	1.42	1.48	.92	.83	.57	.75
75	LAC LA B	.23	4.83	1.31	.16	.86	.73	.85	.79	1.78	1.29	.97
76	MORINVIE	.25	0.00	1.10	1.64	1.40	.67	1.26	.87	.78	.95	1.71
77	RIMBEY	.23	3.27	2.03	.43	1.20	.87	1.42	.27	1.12	.87	1.45
78	COCHRANE	0.00	0.00	0.00	0.00	.26	.76	1.06	.54	2.12	1.27	1.61
79	OKOTOKS	.79	0.00	.74	.55	.94	.77	1.70	1.56	.90	.54	1.53
80	SYLVAN L	.15	0.00	2.24	.53	2.15	1.04	.69	1.05	1.41	.24	.77
81	NISKU	N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
82	NAMAO	N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
83	HIGH LEVEL	.06	10.66	2.07	1.06	1.36	1.61	1.16	.87	.72	1.02	1.18
84	SUNDRE	.12	0.00	3.04	.81	1.74	1.30	1.07	.80	.84	.93	1.18
85	FOX CREEK	0.00	0.00	13.73	0.00	1.30	.47	.24	.34	.35	.47	2.16
86	CORONATIN	.29	0.00	.95	.27	1.44	1.08	1.21	1.00	1.29	.62	1.64
87	SWAN H	0.00	0.00	11.02	0.00	1.34	1.40	.61	0.00	.66	0.00	1.37
88	VULCAN	.65	0.00	.64	.27	1.29	1.24	1.14	.22	1.14	1.15	1.65
89	PROVOST	.57	0.00	.62	.62	1.05	.91	1.80	.65	1.06	.61	1.18
90	3HILLS	.24	0.00	.31	.66	1.41	.60	1.15	1.14	1.54	1.45	.48
91	CROSSFIELD	.35	0.00	1.12	.48	.57	1.65	1.44	.59	1.07	.55	2.04
92	BASSANO	N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
93	TOFIELD	.21	0.00	.34	.44	.70	1.68	1.14	1.09	1.42	.85	1.43
94	BOW IS.	1.37	0.00	0.00	.53	1.14	.97	1.21	1.05	.79	.86	1.81
95	ECKVILLE	0.00	0.00	2.16	.46	.55	.79	1.79	.57	1.53	.26	1.12
96	MANNING	0.00	4.69	0.00	.31	.74	.89	1.49	.77	1.44	.54	2.46
97	GRIMSHAW	.18	0.00	.39	.16	1.47	1.79	1.63	1.02	.91	1.42	.90
98	VAUXHALL	.34	0.00	0.00	2.20	1.31	.90	1.32	.39	.68	1.63	.38
99	VIKING	.53	0.00	.29	.37	.59	2.13	1.19	0.00	1.70	.29	.75
100	OYEN	.59	0.00	0.00	0.00	.39	.38	2.07	.41	1.34	.76	2.00
101	KILLAM	.48	0.00	.78	.50	.60	.76	1.29	2.96	1.42	.56	1.42
102	BASHAW	.59	0.00	1.16	.66	.59	1.13	1.68	1.22	1.10	.57	1.03
103	CASTOR	.49	0.00	1.60	.34	1.49	.65	1.02	.44	1.39	1.18	.83
104	FALHER	1.04	0.00	.75	0.00	1.33	.91	1.24	2.75	1.07	.74	.78
105	MILK RIVER	1.21	0.00	.44	.56	.44	.43	1.79	1.39	1.11	.43	1.14
106	PIC BUTTE	.56	0.00	0.00	2.31	.97	.76	1.32	1.09	1.06	.04	.54
107	BEAVERLDE	.30	0.00	.24	.62	.25	.59	1.11	.76	1.30	2.97	1.13
108	FORESTBURG	.47	0.00	1.52	.43	.81	2.47	1.17	.53	.88	.50	2.11
109	THURSBY	N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
110	BENTLEY	N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
111	LEGAL	N/A	0.00	0.00	0.00	0.00	0.00	[illegible]	[illegible]	0.00	0.00	

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112	ONOWAY	N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
113	SANGUDO	N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
114	LAMONT	.40	0.00	0.00	1.29	.87	.42	.65	0.00	1.70	.64	2.24
115	2HILLS	.22	0.00	0.00	1.51	1.08	.52	1.36	0.00	1.17	1.22	1.66
116	ALIX	N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
117	ELK P,T	.28	0.00	1.39	0.00	.47	.90	2.00	.49	1.39	.45	1.44
118	COLEMAN	0.00	10.33	8.42	1.54	.51	1.08	.67	.71	.70	.34	1.15
119	SPIRIT RIV	.56	10.10	.52	.33	1.19	1.02	1.13	1.10	1.07	1.03	1.63
120	MAYERTHIE	.32	0.00	1.55	.22	1.57	1.01	1.58	1.09	1.06	.76	1.07
121	SMOKY LK.	.12	0.00	.39	.17	.90	1.34	1.03	1.24	1.49	1.35	1.63
122	TROCHU	.41	0.00	.45	.19	.23	.87	1.48	1.88	1.46	.22	2.08
123	DAYSLAND	N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
124	CONSORT	.30	0.00	1.95	.21	.80	.71	1.12	1.51	1.70	0.00	2.03
125	EVANSBURG	N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
126	SEDGEWICK	.49	0.00	1.06	.90	.80	.51	1.21	1.11	1.33	1.30	0.82
127	MUNDARE	N/A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
128	BLACK DID	.40	11.30	3.95	.75	2.45	.64	1.01	0.00	.62	.86	1.14
129	BELLEVUE	0.00	11.90	5.54	1.64	.62	.75	.63	.97	.63	.15	2.40
130	MAGRATH	.71	0.00	0.00	1.81	.59	.56	1.48	.41	.91	.76	1.80
131	COLD LAKE	0.00	0.00	0.00	.33	.40	.64	.60	.93	1.11	5.14	1.22
132	MCCLENNAN	.10	4.38	.34	.44	1.73	2.32	.43	1.08	1.45	1.00	.86
133	BLACKFALDS	.26	0.00	1.72	.73	1.53	2.52	1.32	.45	.86	.21	.90
134	CALMAR	.14	0.00	2.68	.76	2.72	1.52	.68	0.00	.92	.68	1.16
135	MANNVILLE	.57	0.00	0.00	.26	1.56	.90	1.41	1.30	.97	1.21	1.60

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APPENDIX C

ECON BASE ANALYSIS: ALTA. CENTRES.(1971)

INDEX OF SURPLUS LABOUR

		AGRICULT	FORESTRY	MINES/OIL	MANUFACT	CONSTR	TRANSPORT	TRADE	FINANCE	PERSONAL	GOVT/DEF	UNSPEC
11	CALGARY	-19668.07	-451.05	4670.83	4826.80	2817.38	7420.63	5490.51	3708.28	9005.01	-2266.87	-10548.46
12	EDMONTON	-21681.19	-394.84	-3965.94	6634.34	2157.05	4220.24	7397.77	2208.62	10536.32	5852.35	-12993.72
13	LETHBRIDGE	-1782.85	-52.94	-641.81	914.74	-24.14	121.76	953.50	77.41	685.56	52.27	-303.51
14	RED DEER	-1359.69	-34.29	-6.59	-136.45	-155.57	-15.60	449.74	35.57	1262.41	71.20	-110.73
15	MED.HAT	-865.40	-30.85	-267.34	647.42	-239.32	286.15	208.14	-107.39	247.76	56.28	64.53
16	GRD PRAR.	-657.17	72.44	-121.11	44.30	74.24	51.30	264.04	.24	107.53	109.78	54.40
17	SHERD PK	N/A										
18	ST.ALB	-510.63	-13.60	-55.09	99.05	44.82	110.93	133.45	53.70	125.76	103.63	-92.31
19	FT.MCCMUR.	-302.59	7.32	706.05	-182.24	64.09	-47.92	-167.70	-33.98	-161.86	-96.39	134.38
20	LLOYDIN	-364.15	-10.46	110.30	23.85	4.45	43.76	262.21	-17.94	131.64	-134.16	-49.50
21	CAMRCSE	-322.30	-10.53	-85.67	-38.42	-57.46	6.76	226.43	31.14	335.52	-101.13	13.64
22	BROOKS	-145.60	-5.49	94.27	-81.01	45.56	34.94	37.85	7.82	26.90	-23.96	8.73
23	EDSON	-197.92	40.05	61.22	-109.68	64.27	54.21	50.12	-10.57	70.97	-4.80	-17.86
24	ROCKY M.H	-140.04	31.19	130.91	-65.21	43.23	-10.67	67.05	9.38	-40.98	-44.91	20.43
25	WHITECIT	-170.75	10.93	197.63	-22.92	61.75	-2.40	-5.21	-19.74	3.21	-56.60	14.10
26	DRAYTON V	-177.05	-4.22	330.69	-112.46	72.94	23.63	-12.78	-21.58	-14.04	-60.53	-4.62
27	PEACE R.	-252.98	28.02	-54.86	-100.92	-27.16	160.71	57.69	9.65	60.64	87.09	31.88
28	HINTON	-233.12	49.45	88.49	352.17	9.03	3.36	-45.17	-37.92	-93.00	-70.54	-22.75
29	WETASK.	-244.28	-2.13	-30.80	-25.45	-45.97	-28.25	255.32	2.81	223.44	-41.84	-56.85
30	STETTLER	-141.82	-5.40	20.43	-78.29	12.84	-47.68	232.40	-21.08	99.24	-51.60	-19.03
31	WESTLOCK	-107.47	-3.63	-36.77	-64.77	2.80	4.09	46.75	.58	173.71	-35.19	-20.10
32	DRUMHEL.	-151.78	-.28	-8.03	-114.66	-19.11	20.49	133.46	-24.61	64.04	111.54	-1.05
33	TABER	-151.27	-.63	2.53	124.90	-17.87	-58.62	141.04	11.17	5.88	-52.50	-9.62
34	LEDUC	-157.88	-4.63	27.77	-61.06	17.32	102.38	1.17	5.89	70.77	-21.66	20.12
35	FT.SASK	-239.12	3.35	-5.61	554.06	-49.78	-40.57	-120.45	-16.32	-102.36	60.75	-44.93
36	SPRUCE GR	-115.50	-3.35	16.90	3.85	55.04	26.62	56.14	9.07	-18.03	-7.72	-23.03
37	BANFF	-250.76	-5.97	-76.92	-175.53	-121.64	7.20	-35.38	-43.06	572.72	68.45	61.62
38	ST.PAUL	-167.09	.66	-55.85	-81.09	14.89	-14.54	41.16	6.95	171.17	26.32	57.40
39	HIGH RIV	-98.35	-4.37	-21.24	-21.99	-30.87	-30.33	104.65	11.58	43.72	-19.46	66.66
40	CARDSTON	-34.20	1.80	-26.16	-61.61	-11.15	-19.42	53.71	-9.10	59.22	26.22	20.70
41	ATHABASCA	-82.70	7.55	-16.50	-23.93	-2.10	-9.60	58.57	.08	60.43	-4.12	14.31
42	BONNYVIL.	-96.52	7.34	-19.21	-65.29	27.56	-10.15	25.97	-2.49	13.29	20.38	99.10
43	PONOKA	-191.94	-5.76	-34.21	-104.15	9.70	-77.14	14.22	29.51	369.56	-26.05	17.03
44	OLDS	192.53	-3.63	-21.77	-54.77	2.90	-15.41	-76.23	-4.42	33.71	-10.19	-40.10
45	VEGREV.	-110.71	-3.95	-45.83	-94.29	-.20	85.77	105.45	-23.28	43.00	-13.45	57.08
46	WAINWRIT	-125.75	-4.07	-12.37	-102.92	4.75	-42.41	54.74	-34.74	43.21	211.40	-.90
47	VERMILION	-98.65	-3.42	-39.06	-43.42	3.13	-30.36	72.45	-6.65	113.65	45.32	-9.89
48	FT.MACLEOD	-102.27	1.97	-39.04	68.36	-14.96	-10.06	37.94	-27.64	62.69	-24.40	24.79
49	GRND CENTR	-116.60	-2.90	-32.10	-62.54	-29.53	-31.49	[illegible]	6.57	-41.30	324.06	23.14
50	SLAVE L	-88.21	12.90	62.74	-43.50	31.66	24.51	[illegible]	-15.79	8.54	14.43	7.66

51	VALLEYIW	-77.58	-2.09	63.14	-53.05	17.04	14.91	-25.25	-10.51	94.82	-24.68	8.25
52	BARRHID	-105.54	6.53	-14.64	-59.78	-18.01	-34.55	66.03	17.49	112.16	-10.60	29.00
53	INNISFIL	-79.63	-2.61	-3.63	-3.92	-16.29	-47.96	53.24	8.06	51.97	16.56	-9.78
54	CLARESIM	-92.39	-3.39	-28.68	52.49	-61.10	-30.57	43.87	-36.44	174.30	-33.90	-29.14
55	LACOMBE	-24.99	-3.69	-17.54	-71.58	31.28	-37.50	-1.28	-5.15	133.81	-16.76	13.41
56	STONY PL.	-40.61	-1.80	-18.19	-34.43	24.28	-12.98	44.13	-17.03	38.01	17.60	5.32
57	PINCHER CR	-151.38	-4.08	192.43	-83.38	51.17	-37.60	74.03	-4.93	35.98	-41.99	-31.27
58	HANNA	-119.24	-3.32	-17.71	-60.24	-4.20	132.41	72.05	9.43	9.42	-16.93	-2.28
59	HI PRAIRE	-99.12	7.04	-18.07	-4.36	-35.06	1.92	.83	13.84	93.81	32.51	6.66
60	FAIRVIEW	-48.92	-2.36	-15.34	-26.21	-24.82	-12.22	26.12	6.18	127.78	-1.76	-26.45
61	JASPER	-181.54	-4.56	-53.75	-102.89	-30.82	314.52	-50.20	-.80	107.80	40.42	-36.18
62	CANMORE	-94.51	2.75	126.01	-13.04	-17.15	-34.45	46.42	-12.53	21.35	6.00	-30.85
63	BLAIRMIE	-93.25	7.76	106.40	2.87	-6.30	-9.66	-22.07	-27.17	13.60	-3.22	24.90
64	COALDALE	-68.69	-3.54	-40.61	107.95	40.09	-28.53	16.24	-8.32	21.06	-37.63	2.13
65	REDWATER	-29.94	-1.67	23.55	69.65	17.71	1.01	-24.05	-.37	-40.90	-8.66	-1.33
66	DIDSBURY	-78.76	-1.88	65.84	-11.70	-17.62	-14.54	46.33	-12.04	71.96	-9.17	-31.54
67	NANTON	-2.29	-1.25	-11.04	-32.65	-11.62	7.10	42.15	4.76	8.38	-12.65	9.10
68	RAYMOND	6.83	-1.98	-25.51	25.13	-5.29	-37.32	30.05	-4.23	8.39	-26.92	25.86
69	CARSTAIRS	-27.13	-.77	30.14	-23.13	15.57	34.79	11.38	.64	-22.44	-20.06	1.01
70	GRND CACHE	-131.72	6.74	468.06	-78.43	-17.68	-51.00	-59.32	-24.83	-50.66	-45.36	14.21
71	REDCLIFF	-60.30	-2.75	-15.37	246.99	-9.72	-27.53	-38.57	-18.59	-69.05	-16.98	11.87
72	DEVON	-61.79	-1.59	24.51	56.92	24.61	-7.01	-5.27	-4.46	5.22	-11.69	-19.46
73	STRATHIE	-16.12	-1.46	-13.75	-14.00	13.04	21.56	16.55	-2.81	16.24	-8.15	-11.11
74	AIRDRIE	-26.08	-1.34	-7.20	4.63	26.09	14.73	32.61	-1.34	-18.97	-15.01	-6.14
75	LAC LA B	-66.95	7.93	8.33	-52.60	-7.58	-14.69	-14.50	-5.33	131.04	15.72	-1.36
76	MORINVIE	-44.23	-1.41	1.83	27.36	14.19	-12.25	16.82	-2.25	-25.09	-1.97	25.00
77	RIMBEY	-49.27	3.47	20.29	-26.27	11.14	-8.43	32.76	-13.72	15.12	-5.12	17.02
78	COCHRANE	-63.01	-1.50	-19.33	-45.36	-28.10	-9.63	4.28	-8.36	137.57	10.67	22.77
79	OKOTOKS	-18.21	-2.10	-7.06	-26.50	-3.34	-15.49	73.99	14.30	-15.41	-25.07	27.88
80	SYLVAN L	-55.53	-1.56	24.90	-22.17	45.38	3.78	-8.75	.91	52.67	-30.91	-8.72
81	NISKU	N/A										
82	NAMAO	N/A										
83	HIGH LEVEL	-73.76	18.12	25.84	3.30	17.38	30.46	15.35	-2.94	-43.04	.83	8.46
84	SUNDRE	-37.84	-1.02	26.86	-5.84	19.09	8.05	3.51	-2.48	-13.25	-1.75	4.68
85	FOX CREEK	-51.03	-1.22	199.35	-36.74	9.14	-17.10	-46.34	-9.87	-64.17	-16.66	34.84
86	CORONATIN	-30.66	-1.23	-.85	-27.19	13.76	2.50	12.91	-.05	29.60	-12.25	19.47
87	SWAN H	-68.05	-1.62	209.13	-48.99	13.85	17.20	-31.76	-10.89	-42.23	-42.48	14.79
88	VULCAN	-26.87	-1.83	-8.58	-40.34	13.57	11.65	12.02	-17.39	20.63	7.01	29.58
89	PROVOST	-33.76	-1.88	-9.16	-21.70	2.38	-4.54	75.35	-7.94	11.96	-19.17	8.46
90	3HILLS	-80.22	-2.51	-22.27	-25.75	25.37	-25.19	16.54	4.35	110.54	29.31	-32.18
91	CROSSFIELD	-18.96	-.69	1.11	-10.67	-7.53	11.77	15.17	-3.44	3.68	-6.09	17.67
92	BASSANO	-1.26	-.03	-.39	-.91	-.76	-.79	-1.51	-.37	-2.45	-.79	9.26
93	TOFIELD	-37.25	-1.13	-9.49	-14.02	-8.57	20.28	8.21	1.23	38.18	-4.50	12.08
94	BOW IS.	24.47	-1.56	-20.10	-22.17	5.38	-1.22	16.25	.91	-27.33	-5.91	31.28
95	ECKVILLE	-30.24	-.72	10.72	-11.77	-8.29	-4.02	26.05	-3.81	31.23	-13.88	2.13
96	MANNING	-44.73	3.93	-13.72	-22.20	-7.05	-3.14	26.24	-3.03	34.07	-12.93	38.57
97	GRIMSHAW	-69.43	-2.01	-15.90	-50.78	23.95	41.89	58.53	.40	-14.06	22.29	-4.89
98	VAUXHALL	-29.10	-1.05	-13.53	38.25	8.33	-2.74	16.99	-7.85	-10.70	17.47	-16.06
99	VIKING	-26.06	-1.34	-12.20	-25.37	-13.91	35.73	12.01	-16.34	75.03	-25.01	-6.14
100	OYEN	-17.21	-1.01	-12.95	-30.39	-15.53	-16.55	54.27	-7.30	27.97	-6.35	25.06
101	KILLAM	-21.58	-.99	-2.76	-14.94	-10.15	-6.16	10.02	12.69	34.19	-10.96	10.43
102	BASHAW	-17.21	-1.01	2.05	-10.39	-10.53	3.45	34.27	2.70	7.97	-11.35	.06
103	CASTOR	-31.12	-1.46	11.25	-29.00	19.04	-13.44	1.95	-2.91	46.24	6.65	-6.11
104	FALHER	1.53	-1.04	-3.33	-31.30	8.71	-2.35	12.79	22.13	5.52	-7.14	-5.69
105	MILK RIVER	7.83	-.89	-6.40	-11.76	-12.48	-13.36	15.32	4.17	7.70	-13.21	3.03
106	PIC BUTTE	-28.01	-1.50	-19.33	59.64	-3.10	-9.63	24.28	1.64	7.57	-14.33	-17.23
107	BEAVERL,E	-47.42	-1.61	-15.68	-18.53	-30.77	-17.41	[illegible]	-4.65	33.00	82.91	5.16
108	FORESTBURG	-17.13	-.77	5.14	-13.13	-3.43	30.74	[illegible]	-4.30	-7.44	-10.00	21.01
109	THORSBY	N/A										
110	BENTLEY	N/A										
111	LEGAL	N/A										

112	ONUWAY	N/A										
113	SANGUDJ	N/A										
114	LAMUNT	-22.80	-.90	-11.60	7.78	-2.86	-13.76	[illegible]	-11.?1	51.54	-6.60	27.06
115	2HILLS	-35.99	-1.10	-14.11	16.89	2.10	-13.93	14.72	-13.40	15.02	6.29	17.62
116	ALIX	N/A										
117	ELK P.T	-25.28	-.84	4.18	-25.40	-11.34	-2.19	42.60	-6.28	23.44	-12.03	9.12
118	CULEMAN	-81.28	18.06	185.07	31.49	-34.15	3.87	-32.60	-18.[illegible]	-47.94	-33.74	6.47
119	SPIRIT RIV	-27.38	13.51	-9.13	-29.91	7.28	.76	10.03	1.83	8.79	1.65	23.14
120	MAYERTHIE	-86.01	-3.00	21.35	-70.72	43.80	.73	36.59	3.29	15.11	-18.67	5.54
121	SMOKY LK.	-36.58	-.49	-7.76	-24.94	-5.15	8.64	.02	2.89	37.19	9.04	15.43
122	TROCHU	-21.54	-.87	-6.21	-21.31	-17.10	-2.99	21.06	9.35	33.99	-17.11	23.41
123	DAYSLAND	-1.26	-.03	-.39	-.41	-.76	-.79	-1.51	-.37	-2.45	-.7?	9.??
124	CONSORT	-23.39	-.80	9.76	-19.04	-10.10	-6.01	4.87	.27	45.11	-26.65	26.27
125	EVANSBURG	N/A										
126	SEDGEWICK	-15.87	-.74	.53	-2.23	-3.67	-9.42	7.90	1.01	20.01	5.73	-3.24
127	MUNDARE	N/A										
128	BLACK DID	-22.17	9.11	33.60	-6.76	32.52	-8.38	.32	-10.63	-27.24	-3.21	3.03
129	BELLEVUE	-52.92	13.74	73.77	31.90	-12.00	-8.29	-23.01	-.42	-37.84	-28.09	43.73
130	MAGRATH	-12.21	-1.01	-12.95	24.61	-10.53	-11.55	24.27	-7.30	-7.03	-6.35	26.06
131	COLD LAKE	-62.38	-1.49	-19.13	-29.91	-22.72	-14.24	-29.97	-3.17	13.79	161.06	6.14
132	MCCLENNAN	-42.88	3.86	-9.69	-19.47	21.04	30.66	-32.5?	1.05	41.95	.11	-3.30
133	BLACKFALDS	-27.80	-.90	8.40	-7.22	12.14	36.22	14.57	-6.01	-8.46	-16.60	-2.34
134	CALMAR	-31.54	-.87	18.79	-6.31	37.90	12.01	-13.92	-10.65	-6.01	-2.61	3.41
135	MANNVILLE	-11.46	-.63	-8.12	-14.05	9.00	-1.65	13.23	2.29	-1.42	3.48	9.30

REFERENCES

Carter, H. (1975), The Study of Urban Geography, Arnold, London.

Clemente, F. and Sturgis, R.G. (1971), Population Size and Industrial Diversification, Urban Studies, Vol. 8, pp. 65 - 68.

Crowley, R.W. (1971), "Labour Force Growth and Specialization in Canadian Cities". Working Paper A-71-1, Ministry of State for Urban Affairs, Ottawa.

Marshall, J.U. (1975), City Size, Economic Diversity and Functional Type, Economic Geography, Vol. 51, pp. 37 - 49.

Paraskevopoulos, C.C. (1975), "Population Size and the Extent of Industrial Diversification", Urban Studies, Vol. 12, pp. 105 - 107.

Pratt, R.T. (1968), "An Appraisal of the Minimum Requirements Technique", Economic Geography, Vol. 44, pp. 117 - 124.

Ullman, E.L. and Dacey, M.F. (1960), "The Minimum Requirements Approach to the Urban Economic Base". Papers of the Regional Science Association, Vol. 6, pp. 175 - 194.

CHAPTER 4

THE COMMERCIAL CHARACTER OF ALBERTA SERVICE CENTRES IN 1976

I. INTRODUCTION

Chapter 3 has shown that a primary function of the majority of Alberta towns is to act as service centres for their surrounding rural areas and their own population. This is not to deny that other activities occasionally dominate in particular cases, for example, industrial functions, or "bedroom" satellite communities, rather to emphasize the major role of the majority of centres. But even where the commercial role is subordinate to some other economic functions, the service sector of the economy is still a vital part of the characteristics of places. Unfortunately any review of the available literature on service centres in Alberta will reveal that the differentiation of these centres is not particularly well understood. Given the commitment to regional planning in Alberta this is unfortunate. It does seem necessary to understand the commercial character of places--particularly from a province-wide perspective--before any new plans are formulated, or simply to provide a basis for understanding the effect of current pressures for change upon the existing system or set of values.

The major objective of this Chapter is to answer the simple question of whether there are groups of centres in Alberta with sufficiently similar clusters of commercial functions to identify a hierarchy of centres. If such a hierarchy exists, then the types of functions, population levels, etc., at these levels can be identified and the regional variation in these characteristics noted. A Cluster Analysis method is the primary tool to be employed. From this analysis it should be possible to identify the functions missing in particular towns at various levels in the hierarchy. The secondary objective of this chapter is to measure the relationship between the commercial importance of places and the population levels of the centres. In this way, the amount of population "surplus" or "deficiency" of places can be measured, thereby providing additional insight into commercial character of places and the overall variations.

To achieve these objectives the report is divided into sections:

- data sources and organization;
- techniques for service centre analysis;
- techniques used;
- the commercial hierarchy; and
- the concept of population imbalances.

II. DATA SOURCES AND ORGANIZATION

The information used in this chapter was obtained from the latest comprehensive set of telephone directories for Alberta towns at the time of the survey, namely 1977. A total of eighty-three different types of commercial establishments were identified, divided into three broad categories called retail (43 types), service-trade (23 types) and professional (17 types). Chapter 1 has already described the accuracy of the data compared to the similar information that can be obtained from other sources; the alternative sources such as Dunn and Bradstreet or Alberta Bureau of Statistics have been shown to be inaccurate. By way of introduction it is worth noting that a deliberate attempt was made to use only those commercial types that were present in comparatively large numbers in Alberta. Specialized types that had less than 100 outlets in Alberta were combined into more general commercial categories. By removing the effect of the extreme specializations found in the metropolitan centres the emphasis of the study remained at the small town level and, by reason of the characteristics of the Cluster and Functional Index techniques used in the study the approach avoided distortions produced by the presence of a highly specialized commercial type in a centre. Further justification for this decision came from the realization that the descriptions of commercial character given by telephone directories were quite general so it seemed quite unjustifiable to go beyond the eighty or ninety separate functional types.

A "cut-off" figure of three establishments in a centre was used to restrict the number of centres in the analysis. In total, 406 places were identified so the information used in the study consisted of a 46 plane x 83 data matrix. Obviously the restriction of the study to the scale of level of establishment types means that the influence of the differential size of establishment is excluded. This is unfortunate. At this time, there appears to be no way around the limitation--given the inaccuracy of the retail trade figures produced by the Alberta Bureau of Statistics, the only possible source of information on the sales volume of both places and commercial types. Once the provincial wide data set was obtained the information was split into several different matrices. Firstly, the size limitations on the cluster analysis routines meant that the data matrix had to be subdivided into two sections, the 194 towns with greater than 15 establishments and the 206 places with between 3 and 15 establishments. Secondly, the data was duplicated and reorganized into regional planning areas so that separate analysis could be carried out at a regional level. Obviously the decision to "cut-off" at 15 establishments is an arbitrary decision taken on purely practical grounds. It did, however, have the effect of ensuring that the hierarchical analysis was not dominated by small centres.

III. TECHNIQUES FOR SERVICE CENTRE ANALYSIS

A. Problems with Existing Studies

The limitations of the existing studies on the commercial characteristics of Alberta towns have already been described in the preliminary report on the feasibility of the study (Feasibility Report 1978, pp. 4-7). These problems are worth repeating here since they demonstrate that the current analysis have major deficiences which this study is designed to overcome. The problems fall into three categories, comprehensiveness; comparability; and technical deficiencies.

1. Comprehensiveness - Most existing studies, especially of the Regional Planning Commission, are not comprehensive. Since they only deal with particular parts of the province, it is impossible to obtain a province-wide understanding of service centre characteristics.

2. Comparability - The studies are not comparable because of several different types of inconsistency.

a) Time - They have been produced at various times (e.g. Peace River, 1971; Oldman River, 1971; Red Deer, 1976) making it difficult to determine whether differences are due to regional variations or temporal changes.

b) Data -

(i) Sources - Various data sources have been used and these sources will be shown to provide quite different figures. For example: the Peace River study (1971, Appendix 2) appears to use Alberta Bureau of Statistics information; the Oldman River study obtained the data from a personal survey of the area; Davies and Gyuse (1974) used Dunn and Bradstreet data.

(ii) Data Categories - It is vital to differentiate between various categories of retail and service trade, but since the categories used in these sources vary, another source of variation is identified. Hence, it is unlikely that each type of function listed in different sources is placed consistently in a defined category.

(iii) Explicit Data - The studies do not provide the raw data of their studies in an Appendix to the reports - making it impossible to replicate the studies.

c) Techniques - A wide variety of alternative techniques have been used to define hierarchies of centres, the studies by the Regional Planning Commissions being particularly dated in terms of any sophistication of technique. The limitations are best appreciated by a brief summary of some of the studies.

(i) Peace River (1971, p.20). No explicit technique for defining the hierarchy is explained. However, it seems (the word "seems" must be emphasized) that the seven fold grouping was derived by analogy from Christaller's 1933 system based on his largest place, Munich, a ridiculous comparison given the fact that Peace River's largest place was only 12,000 at the time of the study.

(ii) Oldman River (1970) used the breakpoints proposed by the 1975 Royal Commission in Saskatchewan study to define a five fold grouping, e.g. Village level 11-30 functions; Town 31-55 functions, etc. This is a very crude measure since the "cut-off" points seem rather arbitrary and all functions are weighted equally. Also it is likely that the 13-year time gap has produced many changes in the number of functions at any hierarchical level.

(iii) Red Deer (1976) used a points system based on variety of different types of function - including population and industrial size. The logic of the points derivation and assignment is difficult to follow and no justification for the allocation of points is provided. In addition, arbitrary cut-offs are used to produce grades of centre.

(iv) Tjorshelm (1972) produced one of the few province-wide studies. His classification of centres is a modification of a technique first used in England in the 1930's (Smailes, 1942; Dickinson, 1956). A set of categories defined by functions are invented and towns are placed in those categories. Obviously, the utility of the resulting 'hierarchy' depends on the initial assignment of 'marker' functions as grades. No evidence for the utility of the markers is provided so the results must be criticized.

(v) Davies and Gyuse (1975) applied cluster analysis methods to the town/function matrix to define the groups of places in the Calgary area. It was noted that a variety of alternative similarity measures and clustering routines were available so the approach must be treated with care. However, the authors maintained that Ward's method, applied to Euclidean Distance measures, represented the best solution (Ward, 1963) as arbitrary decisions on scaling the data or predetermining the groups are not made. The biggest limitation, apart from the decision on how many groups to interpret, is that the initial hierarchical assignments are perpetuated at future grouping stages, although the adoption of the Discriminant Analysis Tests meant that re-assignments could be made. This method appeared to be the most sophisticated technical analysis of retail-service characteristics of Alberta towns. Its restriction to one small area of the province limits its use.

d) Results - Variations in the data and techniques described above mean that it is fruitless comparing the various studies. Not surprisingly the number of grades of centre vary, for example, from seven groups in Peace River to four (plus a specialized town) in the Calgary area.

IV. TECHNIQUES USED IN THE ANALYSIS

A. Identification of Groups

The presence of groups in the establishment-places matrix was determined by a hierarchical clustering method. The first stage of this approach consisted on the calculation of the similarity between every pair of places over the 83 functions or establishment types, with Euclidean Distance being the measure of similarity. Ward's (1963) method of hierarchical fusion was applied to the similarity matrix since this approach has been shown to represent the most satisfactory clustering methods of this type (Sokal and Sneath (1973); Aitcheson (1974)). At each stage in this approach an Error Sum of Squares (ESS) or Fusion Summary is derived which measures the loss of information from treating the observations, the towns, as groups. The measure is defined as:

$$ESS = \sum_{i=1}^{n} x_i^2 - \frac{1}{n} \sum_{i=1}^{n} x_i^2$$

Where x_i = score of the ith individual

n = number of observations

The basic result of the procedure is to search for the two most similar places and fuse these centres. Then the second, third, fourth most similar places and so on are treated in the same manner until all the places form one group. With this information it is then possible to identify the way in which the centres cluster together to form groups of places. Normally investigators use the break of slope in the array of ESS measures to identify the most suitable place to break off the grouping procedure since there is no precise statistical "cut-off" decision associated with the method. In this study it was discovered that the "break of slope" approach was not a particularly satisfactory procedure, given the range of very different sized centres in the analysis. Indeed, it is worth recalling that the data set consisted of places with very few functions to centres with a complete set of eighty-three establishment types and more to the point with large numbers in those categories. Not surprisingly, therefore, the smaller centres group together very early on in the analysis since the differences between some of the metropolitan and regional centres are much greater than those between the smaller centres. In other words a scale of aggregation problem exists. To accept the Error Sum of Squares value is to ignore the very different size levels in the analysis.

As a result an alternative procedure was adopted. The groups were picked out from the linkage tree diagram and then subjected to a Discriminant Analysis (Nie et al 1975) to test the adequacy of the results. In this way a statistical confirmation, by a very different method, of the groups was obtained. Moreover, this had the additional advantage of removing the basic criticism of any hierarchical clustering procedure, the fact that once a place is grouped the grouping remains intact at higher grouping levels, even though an individual place may be nearer to some other higher order group. At this time, the combination of the Cluster Analysis-Discriminant Analysis procedure does appear to solve most of the outstanding problems associated with the definition of groups in any town set. However, it must be accepted that further work is needed to determine whether some alternative procedures such as non-hierarchical methods (Barrett 1978) provide different results.

Figure 4-1 shows the results of the application of the Cluster Analysis procedure to the 194 town data set (all centres greater than 15 functions). The presence of nine clusters, two divided into (a) and (b) categories on the basis of the information found in the functional content of the groups, seem quite clear. However, four centres, marked with asterisks--on Table 4-1 show the places misclassified according to the Discriminant Analysis. They are Hardisty and McClennan which should be in Group VI (not Group VIIb) and Sangudo and Lamont, in Group VIIb (not Group VI). The variation between the two analysis are, therefore, quite minor--which represents an encouraging basis for the interpretation of the groups.

Figure 4-1

Dendogram for Cluster Groups

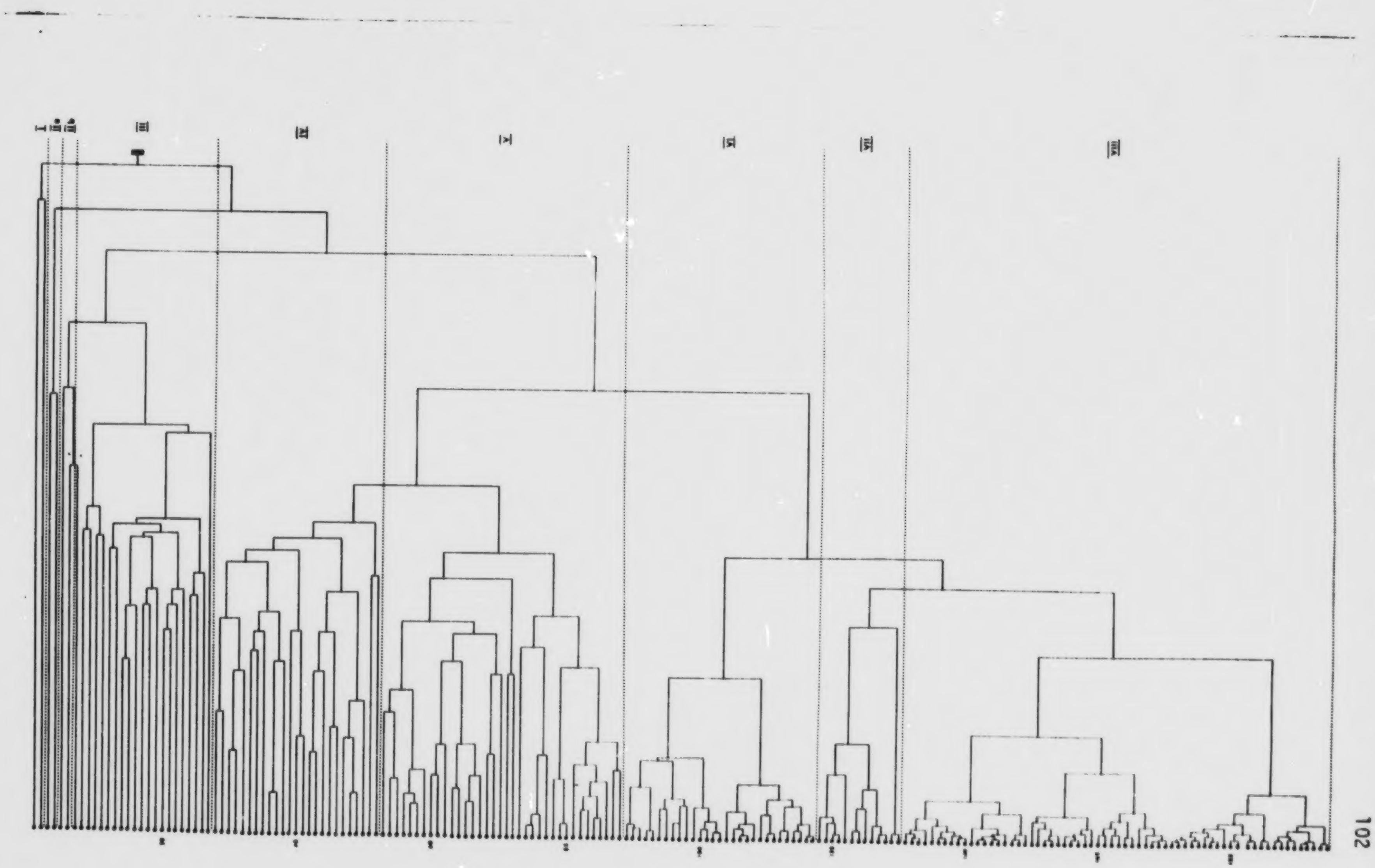


Table 4-1

Membership of Groups: Summary Statistics

Group	PLACE	ESTABS: TOT	RETAIL	SERV	PROF	FUNCTS	ESTAB/FUNCT	F.INDEX	'76POP
I	1 EDMONTON	18130.	5836.	7159.	5135.	83.0	218.434	2429.816	461361.
	2 CALGARY	17230.	5760.	7295.	4175.	83.0	207.699	2432.046	469917.
IIa	3 LETHBRIDGE	1758.	697.	636.	425.	82.0	21.439	263.044	46752.
	4 RED DEER	1505.	520.	686.	299.	83.0	18.133	209.060	32184.
IIb	5 MED. HAT	1120.	430.	446.	244.	82.0	13.659	164.683	32811.
	6 GRND PRAR	731.	278.	286.	167.	79.0	9.253	104.429	17626.
	7 SHERD. PK	524.	136.	301.	87.	71.0	7.380	64.548	26536.
	8 ST. ALBERT	411.	119.	197.	96.	71.0	5.789	57.787	24129.
	9 FT.MACML.	418.	149.	202.	67.	76.0	5.500	62.088	15424.
	10 LLOYDMIN.	435.	200.	150.	85.	73.0	5.959	60.653	10311.
	11 CAMROSE	425.	196.	131.	98.	77.0	5.519	70.539	10104.
	12 BROOKS	336.	115.	155.	66.	68.0	4.941	46.699	6338.
	13 EDSON	282.	97.	146.	39.	66.0	4.273	38.115	4038.
	14 ROCKY MTN.	225.	88.	101.	36.	63.0	3.571	33.288	3432.
III	15 WHITECOURT	192.	76.	93.	23.	61.0	3.148	27.646	3878.
	16 DRAYTON V.	229.	99.	100.	30.	67.0	3.418	35.639	4303.
	17 PEACE R.	269.	113.	97.	59.	73.0	3.685	42.478	4848.
	18 HINTON	264.	111.	98.	55.	68.0	3.875	41.125	6732.
	19 WETASKIWAN	285.	128.	95.	62.	67.0	4.246	43.529	6754.
	20 STETTLER	255.	130.	75.	50.	69.0	3.688	40.600	4182.
	21 WESTLOCK	226.	96.	70.	60.	62.0	3.637	38.374	3728.
	22 DRUMHELLER	265.	115.	100.	51.	68.0	3.897	39.793	6154.
	23 TABER	240.	111.	85.	44.	63.0	3.798	38.461	5296.
	24 LEDUC	279.	106.	115.	58.	67.0	4.164	39.421	8578.
	25 FORT SASK	223.	90.	90.	43.	64.0	3.484	32.574	6304.
	26 SPRUCE GRV	224.	68.	116.	40.	56.0	4.000	27.031	0.
	27 BANFF	314.	149.	130.	35.	60.0	5.233	58.619	3410.
	28 ST. PAUL	206.	94.	67.	45.	68.0	3.029	33.657	4337.
	29 HIGH RIVER	180.	89.	56.	35.	63.0	2.857	30.074	3398.
	30 CARDSTON	142.	62.	55.	25.	56.0	2.541	20.743	3043.
	31 ATHABASCA	141.	59.	61.	22.	50.0	2.820	20.346	1759.
	32 BONNYVILLE	164.	78.	56.	31.	59.0	2.780	27.625	2885.
	33 PONOKA	196.	102.	59.	35.	68.0	2.882	36.962	4636.
	34 OLDS	181.	88.	65.	28.	56.0	3.223	26.164	3658.
	35 VEGREVILLE	189.	87.	58.	45.	61.0	3.098	29.177	4156.
	36 WAINWRIGHT	162.	76.	53.	34.	56.0	2.893	25.318	3890.
	37 VERMILION	142.	62.	49.	31.	55.0	2.573	20.184	3182.
IV	38 FORT MACD.	152.	67.	63.	22.	54.0	2.819	23.425	3067.
	39 GRND CENTR	158.	66.	62.	30.	64.0	2.461	25.926	2780.
	40 SLAVE L.	146.	63.	66.	17.	54.0	2.704	21.019	3561.
	41 VALLEYVIEW	134.	46.	71.	17.	50.0	2.682	19.859	1716.
	42 BARRHEAD	179.	82.	55.	43.	60.0	2.983	29.594	2944.
	43 INNISFAIL	163.	73.	52.	38.	61.0	2.664	28.505	2897.
	44 CLARESHOLM	165.	87.	58.	20.	61.0	2.705	28.884	3276.
	45 LACOMBE	169.	72.	55.	42.	61.0	2.770	27.211	3088.
	46 STONY PL.	143.	56.	55.	32.	57.0	2.509	21.244	2717.
	47 PINCHER CK	159.	69.	57.	33.	64.0	2.484	26.009	3448.
	48 HANNA	135.	67.	44.	24.	60.0	2.250	22.623	2627.
	49 HI PRAIRIE	118.	58.	38.	22.	54.0	2.176	21.028	2281.
	50 FAIRVIEW	116.	50.	44.	22.	50.0	2.320	20.438	2248.
	51 JASPER	125.	49.	62.	14.	39.0	3.205	17.384	3404.
	52 CANMORE	124.	44.	55.	26.	45.0	2.756	17.466	1927.
	53 BLAIRMORE	119.	59.	45.	16.	51.0	2.333	18.908	2322.
	54 COALDALE	110.	48.	43.	20.	54.0	2.033	18.685	3654.
	55 REDWATER	78.	32.	32.	15.	43.0	1.814	12.032	1493.
	56 DIDSBURY	96.	49.	30.	17.	50.0	1.920	17.446	2153.
V	57 NANTON	82.	41.	29.	12.	40.0	2.038	12.685	1152.
	58 RAYMOND	61.	26.	23.	12.	32.0	1.906	8.360	2290.
	59 CARSTAIRS	59.	29.	19.	11.	32.0	1.844	7.620	1659.
	60 GRND CACHE	106.	48.	44.	14.	55.0	1.927	16.455	4116.

	61	REDCLIFF	74.	25.	39.	10.	33.0	2.242	9.369	3606.
	62	DEVON	87.	36.	39.	12.	49.0	1.813	15.009	2706.
	63	STRATHMORE	102.	46.	40.	16.	47.0	2.160	14.557	1561.
	64	AIRDRIE	92.	39.	36.	17.	45.0	2.044	13.667	1408.
	65	LAC LA BIC	101.	46.	40.	15.	50.0	2.010	16.297	1954.
	~~66~~	~~MORINVILLE~~	~~96.~~	~~37.~~	~~35.~~	~~14.~~	~~42.0~~	~~2.048~~	~~12.200~~	~~2097.~~
	67	RIMBEY	92.	52.	26.	15.	48.0	1.917	14.581	1452.
	68	COCHRANE	113.	50.	44.	19.	51.0	2.206	17.061	1458.
	69	OKOTOKS	94.	39.	31.	24.	51.0	1.843	15.679	1793.
	70	SYLVAN L.	91.	35.	45.	11.	43.0	2.116	14.971	1837.
	71	NISKU	68.	21.	36.	11.	22.0	3.091	9.237	298.
	~~72~~	~~NAMAO~~	~~62.~~	~~15.~~	~~40.~~	~~7.~~	~~25.0~~	~~2.400~~	~~10.647~~	~~2252.~~
V	73	HIGH LEVEL	90.	42.	42.	6.	37.0	2.432	12.305	1562.
	74	SUNDRE	86.	37.	37.	12.	46.0	1.859	13.157	1098.
	75	FOX CRK.	55.	21.	29.	5.	26.0	2.696	6.110	1623.
	76	CORONATION	69.	32.	29.	8.	40.0	1.725	11.496	1198.
	77	SWAN HILLS	55.	14.	40.	2.	25.0	2.200	7.150	2012.
	~~78~~	~~VULCAN~~	~~103.~~	~~57.~~	~~76.~~	~~21.~~	~~59.0~~	~~2.062~~	~~10.919~~	~~1418.~~
	79	PROVOST	90.	51.	23.	16.	48.0	1.869	15.632	1532.
	80	3 HILLS	79.	40.	22.	17.	44.0	1.795	12.910	1564.
	81	CROSSFIELD	64.	28.	31.	5.	32.0	1.997	8.442	772.
	82	BASSSANO	63.	27.	28.	8.	37.0	1.703	8.986	998.
	83	TOFIELD	66.	38.	22.	6.	33.0	2.000	10.214	1128.
	~~84~~	~~BOW ISLAND~~	~~69.~~	~~39.~~	~~21.~~	~~9.~~	~~36.0~~	~~1.903~~	~~9.818~~	~~1296.~~
	85	ECKVILLE	59.	30.	23.	6.	33.0	1.788	9.984	774.
	86	MANNNING	79.	37.	33.	10.	37.0	2.135	12.315	1038.
	87	GRIMSHAW	74.	40.	28.	6.	33.0	2.227	10.492	1665.
	88	VAUXHALL	66.	34.	25.	7.	32.0	2.063	9.776	954.
	89	VIKING	65.	35.	20.	10.	41.0	1.585	11.463	1217.
	~~90~~	~~OYEN~~	~~60.~~	~~31.~~	~~21.~~	~~9.~~	~~41.0~~	~~1.463~~	~~10.106~~	~~962.~~
	91	KILLAM	46.	23.	14.	9.	24.0	1.917	5.556	887.
	92	BASHAW	62.	30.	23.	9.	39.0	1.590	10.224	773.
	93	CASTOR	59.	33.	18.	8.	36.0	1.639	9.459	1207.
	94	FALHER	63.	33.	18.	12.	38.0	1.658	10.898	1128.
	95	MILK RIVER	56.	28.	19.	9.	36.0	1.556	10.826	814.
	~~96~~	~~PIC.BUTTE~~	~~48.~~	~~25.~~	~~14.~~	~~12.~~	~~37.0~~	~~1.297~~	~~7.740~~	~~2106.~~
	97	BEAVERLODG	59.	29.	18.	12.	49.0	1.470	9.644	1332.
	98	FORESTBURG	44.	25.	14.	5.	30.0	1.467	8.088	808.
	99	THORSBY	54.	30.	20.	4.	37.0	1.459	11.234	657.
	100	BENTLEY	49.	22.	20.	8.	33.0	1.485	7.827	738.
VI	101	LEGAL	41.	15.	21.	5.	24.0	1.688	5.256	876.
	~~102~~	~~ONOWAY~~	~~46.~~	~~25.~~	~~17.~~	~~4.~~	~~29.0~~	~~1.625~~	~~6.432~~	~~446.~~
	*103	SANGUDO	40.	22.	12.	6.	23.0	1.739	5.771	409.
	*104	LAMONT	44.	21.	16.	7.	27.0	1.630	7.327	997.
	105	2 HILLS	52.	26.	20.	6.	31.0	1.677	8.787	941.
	106	ALIX	36.	22.	11.	3.	24.0	1.479	5.613	669.
	107	ELK POINT	48.	26.	16.	6.	35.0	1.371	8.251	807.
	~~108~~	~~COLEMAN~~	~~42.~~	~~19.~~	~~14.~~	~~5.~~	~~29.0~~	~~1.482~~	~~5.914~~	~~2342.~~
	109	SPIRIT R.	58.	27.	21.	10.	35.0	1.643	10.070	1028.
	110	MAYERTHORP	60.	31.	19.	10.	39.0	1.538	10.248	1018.
	111	SMOKY LK.	48.	24.	13.	11.	34.0	1.412	7.664	925.
	112	TROCHU	51.	27.	12.	12.	35.0	1.457	7.355	752.
	113	DAYSLAND	42.	26.	12.	10.	31.0	1.355	8.344	615.
	~~114~~	~~CONSORT~~	~~42.~~	~~21.~~	~~13.~~	~~7.~~	~~33.0~~	~~1.227~~	~~6.800~~	~~608.~~
	115	EVANSBURG	34.	15.	13.	6.	27.0	1.259	5.461	671.
	116	SEDGEWICK	37.	16.	12.	9.	29.0	1.259	4.625	825.
	117	MUNDARE	32.	16.	11.	5.	24.0	1.333	3.803	955.
	118	ELLERSLIE	40.	18.	26.	4.	20.0	1.975	6.630	884.
	119	BLACK DIAM	38.	15.	19.	4.	24.0	1.563	3.849	1242.
VII	~~120~~	~~PENHOLD~~	~~20.~~	~~10.~~	~~10.~~	~~0.~~	~~10.0~~	~~1.556~~	~~3.396~~	~~772.~~
2	121	COUTTS	23.	9.	15.	0.	12.0	1.917	2.473	387.

	122	ANDRUSSAN	44.	11.	32.	1.	20.0	2.175	5.703	126.
	123	BLACKFALDS	39.	18.	18.	3.	22.0	1.773	6.336	1024.
	124	MILLET	33.	10.	17.	6.	22.0	1.477	4.095	762.
	125	WINTERBRN.	33.	17.	21.	0.	14.0	2.357	4.255	114.
VII a	126	TURNER V.	36.	20.	12.	4.	24.0	1.479	5.757	1132.
	127	CALMAR	38.	16.	18.	4.	28.0	1.339	6.197	872.
	128	BOWDEN	31.	14.	15.	2.	21.0	1.476	3.717	661.
	129	WATER PK.	40.	15.	23.	2.	20.0	2.000	6.281	142.
	130	L.LOUISE	19.	7.	12.	0.	9.0	2.375	2.422	140.
	131	BOYLE	36.	19.	12.	5.	30.0	1.183	5.257	576.
	#132	HARDISTY	35.	20.	11.	4.	25.0	1.400	5.816	534.
	133	CHAMPION	19.	8.	8.	3.	10.0	1.900	1.374	300.
	134	MYRNAM	26.	13.	12.	1.	15.0	1.733	3.141	396.
	135	SEXSMITH	32.	16.	14.	2.	22.0	1.455	3.622	770.
	136	THORHILD	27.	18.	4.	5.	20.0	1.350	4.163	533.
	137	ANDREW	26.	15.	7.	4.	19.0	1.368	3.373	486.
	138	HOLDEN	29.	16.	11.	2.	18.0	1.611	3.312	393.
	139	HYTHE	26.	10.	12.	4.	20.0	1.300	2.974	400.
	140	WILLINGDON	22.	11.	8.	3.	19.0	1.158	3.180	308.
	141	LINDEN	24.	14.	7.	3.	17.0	1.412	3.167	296.
	142	CARBON	22.	15.	4.	3.	20.0	1.100	3.017	435.
	143	GLENDON	20.	13.	6.	1.	15.0	1.333	2.827	370.
	144	BLACKIE	17.	10.	3.	4.	16.0	1.056	2.752	223.
	145	STANDARD	16.	9.	4.	3.	17.0	.941	2.009	305.
	146	ROCKYFORD	22.	15.	6.	1.	17.0	1.294	2.996	276.
	147	FOREMOST	28.	18.	4.	6.	18.0	1.520	3.385	534.
	148	WARNER	21.	10.	8.	3.	16.0	1.313	2.910	434.
VIIb	149	IRMA	26.	13.	12.	1.	18.0	1.444	2.648	428.
	150	COLD LAKE	41.	21.	14.	6.	28.0	1.464	7.706	1317.
	#151	MCLENNAN	27.	9.	10.	8.	20.0	1.350	4.140	1133.
	152	MANNVILLE	30.	17.	9.	4.	22.0	1.364	4.150	681.
	153	BRETON	24.	13.	7.	5.	20.0	1.200	3.956	424.
	154	MAGRATH	35.	18.	11.	6.	25.0	1.400	3.206	1315.
	155	HUGHENDEN	21.	11.	7.	3.	17.0	1.206	2.464	236.
	156	WARBURG	20.	12.	4.	4.	16.0	1.250	2.157	408.
	157	WASKATENAU	18.	14.	2.	2.	13.0	1.385	2.290	272.
	158	ELNORA	16.	8.	3.	5.	12.0	1.333	2.360	211.
	159	DELBURNE	25.	17.	5.	4.	17.0	1.471	2.772	417.
	160	CAROLINE	27.	12.	11.	4.	18.0	1.500	3.592	385.
	161	WILDWOOD	28.	13.	13.	2.	16.0	1.750	3.866	360.
	162	BRUDERHEIM	20.	10.	10.	0.	15.0	1.333	4.297	484.
	163	RYCROFT	31.	16.	8.	7.	24.0	1.292	5.009	333.
	164	NOBLEFORD	19.	10.	9.	1.	12.0	1.583	1.715	417.
	165	BEISEKER	34.	19.	11.	4.	23.0	1.478	4.469	486.
	166	VILNA	32.	20.	9.	4.	21.0	1.524	4.458	348.
	167	LA CRETE	26.	17.	7.	2.	15.0	1.700	3.374	349.
	168	MARWAYNE	24.	13.	10.	1.	18.0	1.333	3.706	376.
	169	HINES CRK	17.	14.	2.	1.	12.0	1.417	2.607	305.
	170	DUCHESS	16.	11.	5.	0.	10.0	1.600	1.705	343.
	171	ACME	25.	10.	12.	3.	23.0	1.065	4.024	351.
	172	ENTWHISTL	17.	7.	9.	1.	13.0	1.308	1.472	380.
	173	RYLEY	20.	9.	9.	2.	13.0	1.538	1.706	432.
	174	INNISFREE	18.	7.	9.	2.	16.0	1.125	2.105	265.
	175	[illegible]	16.	9.	7.	1.	13.0	1.231	2.636	50.
	176	GIBBONS	25.	11.	10.	4.	20.0	1.250	3.602	1093.
	177	KINUSO	19.	10.	8.	1.	14.0	1.357	2.665	305.
	178	GRANUM	18.	9.	8.	1.	15.0	1.167	2.099	413.
	179	ALTA BECH	19.	5.	10.	4.	14.0	1.321	2.705	432.
	180	COWLEY	17.	7.	8.	2.	10.0	1.700	.869	284.
	181	DE WINTON	16.	5.	11.	0.	11.0	1.455	1.002	75.
	182	BELLVUE	23.	12.	8.	3.	18.0	1.278	3.306	1186.
	183	BRAGG CRK	18.	5.	12.	1.	9.0	1.944	1.092	384.
	184	BON ACCORD	20.	7.	11.	2.	15.0	1.333	3.076	882.
	185	IRVINE	17.	8.	8.	1.	10.0	1.700	1.335	221.
	186	CLYDE	22.	6.	14.	3.	17.0	1.294	3.474	312.
	187	RAINBOW 6	19.	3.	14.	2.	12.0	1.583	1.710	434.
	188	WINFIELD	16.	8.	7.	1.	9.0	1.778	1.747	206.
	189	STAVELY	23.	8.	13.	2.	14.0	1.607	3.362	432.
	190	EDGERTON	25.	15.	10.	1.	19.0	1.316	3.289	324.
	191	MITCH JUNC	22.	12.	9.	1.	17.0	1.265	2.884	55.
	192	BERWYN	22.	10.	10.	2.	18.0	1.222	2.706	433.
	193	TILLY	20.	7.	12.	1.	12.0	1.667	1.849	329.
	194	HANNA	15.	6.	8.	1.	11.0	1.364	2.920	206.

B. Population Imbalances of Places

The Functional Index Technique (Davies 1965) has been used by a variety of investigators as a summary measure of the importance of places (Marshall 1964, McCutcheon 1977) and as a method for grouping centres. However, since the technique really provides a relative measure of centrality in any area, it is possible to directly compare these values with the population figures. Appendix A of this chapter, shows the calculations involved. In the Functional Imbalance section the Functional Index for any centre is converted into a ratio value by dividing by the number of establishment types in the study area that contributed to its value. This can be directly compared to the percentage of the study area population present in the centre. In this way, a precise measurement of the population imbalance, its "excess" or deficiency can be obtained in terms of a score based on 100. By multiplying these values by the study area population totals the "imbalance" score can be converted directly into population values. In the analysis two separate calculations of imbalances were made, one based on the latest population of the centre (1976), i.e. Centre Population, the other upon what is described as the Local Population. This consists of the population of the centre, plus the township in which it lies. In this way, the distortions of the service centre populations produced by the vagaries of the political or administrative definitions of the centres are reduced. The population immediately outside the boundaries of the centre, is, therefore, included in the population total to provide, perhaps, a more satisfactory indication of the size of a centre.

V . THE COMMERCIAL HIERARCHY

Nine groups of places were identified using the hierarchical clustering technique (see Figure 4-1, page 102) and the general structure of the groups was confirmed by a Discriminant Analysis in which only four centres were shown to be misclassified. The characteristics of the groups are shown in Table 4-2 in which median as well as average values are shown when the numbers in each group are greater than two. It is apparent that a series of discrete population levels can be identified with averages of 447(VIIb), 629 (VIIa), 874 (VI), 1688 (V), 3117 (IV), 7926 (III) for the lowest groups. Apart from Group VIIa, (this will be shown to be a specialized subset of Group VII(b), there is an approximate doubling of the population at each successive grade.

Table 4-2

Selected Characteristics of Groups: Alberta 1977

Group	No. of Places	Population	Functional Index	Total Establishments	Different Functions	Retail	Numbers in: Service Trades	Professional	Establishment Function Ratio	Population Deficiency Ratio*	Local Deficiency Ratio*	*Ratio Values
1	2	465,639	2,430.9	17,684	83	5,802	7,227	4,655	213.1	-4.036	-4.036	1,884,000 = 18,840 = 1,884 =
2a	2	39,468	236.1	1,631	83	608	661	362	19.8	-0.704	-0.74	188 =
2b	2	25,218	134.6	925 (81)	81	354	366	205	11.5	-0.253	-0.244	
3	21	7,926.8 (6,154)	44.7 (40.6)	301 (269)	67.3 (67.3)	118.6 (113)	126 (101)	56.3 (55.0)	4.4 (4.0)	-0.100 (-0.176)	-0.067 (-0.154)	
4	25	3,117.1 (3,067)	24.9 (25.3)	155.5 (157.5)	57.0 (57)	69.7 (67)	56.2 (55.5)	29.6 (30.0)	2.73 (2.76)	-0.131 (-0.130)	-0.115 (-0.117)	
5	36	1,688.2 (1,533)	12.6 (12.3)	81.5 (79.2)	40.3 (40.5)	37.1 (37.1)	32.5 (31.2)	11.9 (11.9)	2.1 (2.0)	-0.06 (-0.07)	-0.048 (-0.058)	
6	29	874.0 (825)	7.96 (7.8)	48.7 (48)	32.4 (33.3)	24.5 (24.5)	16.3 (17.0)	7.88 (8.13)	1.51 (1.48)	-0.049 (-0.050)	-0.036 (-0.041)	
7a	13	629.2 (762)	4.70 (4.26)	33.77 (35.5)	19.5 (20.3)	12.62 (12.0)	18.88 (18.03)	2.27 (2.25)	1.81 (1.77)	-0.023 (-0.221)	-0.010 (-0.006)	
7b	64	447.3 (394)	3.069 (2.975)	23.0 (22.0)	16.7 (16.6)	11.7 (11.0)	8.6 (8.6)	2.69 (2.04)	1.40 (1.36)	-0.013 (-0.014)	-0.003 (-0.005)	

A roughly similar relationship occurs in the Functional Index Figures--again with the exception of VIIa. Increases in the number of establishments and the general types of function found at each group level are also found which reinforce the idea of a consistent set of grades. However, the increase in the average number of establishments from 32 to 40 in Groups VI to V is only half the normal increase in values. The distinctness of VIIa is also shown by the ratio between numbers of establishments and numbers of different functions where the 1.8 value is greater than the Group VII (1.4) or Group V (1.5) places because the centres in the set add establishments of the same type instead of new types.

Just because there are groups of centres does not, of course, mean that the groups are hierarchical. This is a situation in which the higher order grades of places contain all the functions at a lower level as well as adding additional types. However, Table 4-3 shows that there is a hierarchical sequence in the area, as well, Figure 4-2 represents the distribution of the grades. Each successive grade with the partial exception of Group VIIa contains a set of new types of establishment as well as increasing the number of establishments of any type at the higher levels. The consistency of this sequence identified in Table 4-3 must be emphasized; only a handful of the centres do not conform to this generalization. It is worth noting that where the average number of establishments does not reach 1.0 the type is included at a hierarchical level if the model class is 1.0.

The lowest grade identified in this analysis is composed of the 64 centres of Grade VIIb with 9 distinctive functions. However, the variation in the number of new establishments at any level varies as shown by Grade VIIa only one new type of function (excavating) is added. Hence, this group was described in a subdivision of Group VII. Nevertheless, it is distinctive in that other service-trade types such as construction and trucking have far higher values than Group VIIb or VI. Since the majority of the towns in this group are economically specialized centres and many are found on the fringes of metropolitan areas it is apparent that this group represents a rather aberrant type to the general hierarchical sequence.

The 29 Group VI towns have an average population level of 874 and contain an additional 12 new functional types including professionals (doctors, insurance), specialist trades and services and specialist retail

Table 4-3

Number of Establishments of Each Group

			Grades								
Group	Number	Functional Type	7b	7a	6	5	4	3	2b	2a	1
IIb	8)	Gas Station (and Garage)	2.1	2.8	3.6	4.7	8.1	15.1	49.5	68.5	1,135.0
	4)	General Store (and Grocery)	1.9	1.5	2.5	3.3	5.9	8.9	18.8	37.0	350.0
	46)	Bulk Fuel and Feed	1.9	0.5	3.3	4.4	6.3	6.8	16.0	24.0	42.5
	93)	General Construction	1.2	3.4	1.8	6.5	9.9	27.3	87.5	170.0	1,252.0
	98)	Other Services or Trades	1.1	3.8	1.4	3.4	5.3	17.7	31.5	96.5	1,200.0
	96)	Trucking	1.1	2.4	1.7	4.4	6.0	13.9	48.0	75.3	630.0
	59)	Hotel (and Motel)	1.1	2.4	1.8	2.7	6.5	8.9	22.5	23.0	160.0
	60)	Restaurant (or Cafe)	1.1	1.7	2.0	3.0	6.6	11.0	33.5	46.0	630.0
	62)	Bank	0.8*	0.3	1.6	1.7	2.9	4.7	9.5	12.5	200.0
VIIa	86)	Excavating	0.3	1.3	0.5	1.4	1.9	4.4	10.0	14.5	180.0
	76)	Doctor	0.5	0.4	1.6	1.8	4.7	10.2	38.0	69.0	750.0
	65)	Insurance	0.5	0.4	1.6	1.6	4.0	6.5	23.5	44.0	425.0
	55)	Beauty Parlour	0.5	0.8	1.5	1.5	2.8	4.9	17.5	27.0	280.0
	45)	Building Materials	0.7	0.8	1.4	1.6	3.5	4.4	12.5	36.0	105.0
	47)	Farm Equipment	0.7	0.2	1.3	1.6	3.5	5.8	16.0	28.5	190.0
	81)	Plumbing/Heating	0.4	0.4	1.1	1.7	3.4	6.4	20.5	38.0	247.0
	80)	Blacksmith/Welder	0.6	0.5	1.1	2.0	2.9	7.0	15.0	18.8	167.5
	6)	Supermarket	0.3	0.3	1.0	1.1	1.4	2.3	3.8	7.0	52.5
	24)	Liquor/Beer Sales	0.3	0.2	0.9*	0.8	0.9	1.0	1.5	3.0	22.5
	11)	Auto Parts	0.2	0.3	0.9*	1.6	3.4	6.3	17.0	30.0	362.5
	21)	Hardware	0.7	0.7	0.9*	1.5	2.6	3.6	10.8	20.0	82.0
	23)	Drug Store	0.2	0.3	0.9*	1.2	2.4	3.8	8.5	18.5	162.0
V	10)	Auto Sales	0.6	0.1	0.9	1.5	3.1	4.5	20.5	20.5	202.0
	18)	Appliances	0.1	0.2	0.8	1.4	3.0	6.8	26.5	40.5	393.0
	60)	Real Estate	0.3	0.6	0.7	1.5	3.2	6.8	25.5	39.0	685.0
	16)	General Clothing	0.2	0.3	0.6	1.2	2.3	3.1	10.5	13.5	75.0
IV	64)	Lawyers	0.0	0.0	0.5	0.9	2.6	4.8	18.0	33.5	728.5
	67)	Accountant	0.1	0.0	0.4	0.8	2.4	4.2	19.0	45.0	347.5
	63)	Credit Union	0.0	0.0	0.3	0.6	1.6	1.8	10.5	3.5	60.0
	56)	Laundry/Dry Cleaning	0.0	0.0	0.3	0.6	1.6	2.2	8.0	11.5	106.0
	30)	Sports	0.1	0.3	0.2	0.7	1.5	3.5	5.5	12.0	122.5
	72)	Dentist	0.0	0.0	0.1	0.2	1.4	3.6	9.5	24.0	265.0
	34)	Mobile Homes	0.1	0.4	0.2	0.6	1.4	2.4	3.0	15.0	65.0
	14)	Men's Clothes	0.1	0.1	0.2	0.4	1.3	1.8	6.0	6.3	100.0
	83)	Misc. Repairs (Shoes, etc.)	0.2	0.3	0.4	0.5	1.3	3.2	9.5	23.0	212.5
	5)	Meat	0.3	0.1	0.5	0.6	1.3	1.9	3.0	9.0	92.5
	27)	Florist	0.0	0.0	1.2	0.7	1.2	1.9	4.5	10.0	
	73)	Vet	0.1	0.1	0.5	0.9	1.2	2.2	4.5	5.0	90.0
	25)	Jeweller	0.1	0.0	0.1	0.4	1.2	2.1	6.0	11.8	113.0
	1)	Bread and Bakery	0.1	0.2	0.3	0.8	1.2	1.2	4.0	7.0	66.5
	74)	Optometrist/Optician	0.0	0.0	0.1	0.4	1.2	2.2	7.5	18.5	135.0
	17)	Furniture	0.1	0.3	0.4	0.5	1.1	2.8	13.0	16.0	102.5
	54)	Barber	0.1	0.1	0.3	0.5	1.1	1.9	7.5	8.0	145.0

*Mode is 1.0

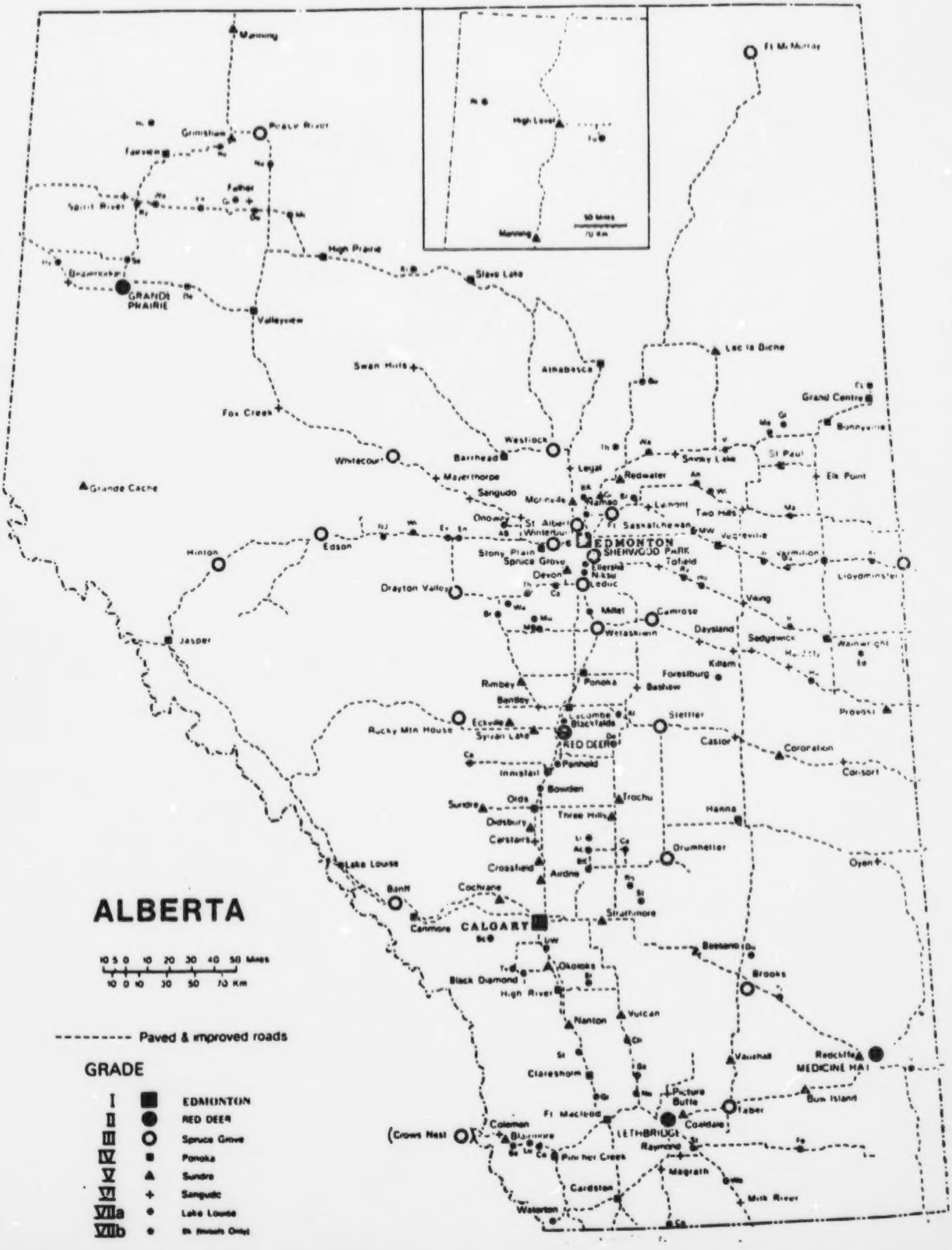
Table 4-3

Number of Establishments of Each Group

roup	Number	Functional Type	7b	7a	6	5	4	3	2b	2a	1
	15)	Women's Clothes	0.1	0.2	0.4	0.7	1.1	2.1	8.5	15.0	155.0
	29)	Gifts, Novelties	0.1	0.4	0.1	0.3	1.1	2.9	5.0	9.5	140.0
	75)	Chiropractor	0.0	0.0	0.1	0.5	1.1	2.1	5.5	11.0	90.0
	61)	Auctioneer	0.2	0.1	0.3	0.4	1.1	0.9	2.5	7.0	27.5
	32)	Catalogue Centre	0.0	0.1	0.7	0.7	1.0	0.7	1.0	0.5	11.0
	2)	Confectionery	0.2	0.1	0.4	0.4	1.0	1.9	5.0	9.0	32.5
	28)	Crafts, Hobbies	0.1	0.5	0.1	0.4	1.0	2.1	5.0	14.5	72.5
	87)	Painter/Decorator	0.1	0.1	0.2	0.5	1.0	3.2	16.5	28.3	285.0
	40)	Photographer	0.0	0.0	0.0	0.0	0.7	0.8	6.5	12.5	200.0
III	94)	Cleaning	0.1	0.3	0.1	0.3	0.4	3.1	8.0	24.5	320.0
	77)	Management Cons't	0.0	0.2	0.0	0.2	0.7	2.5	11.0	15.0	167.5
	71)	Travel Agent	0.0	0.0	0.1	0.3	0.8	1.9	5.5	8.0	140.0
	22)	Garden Centre	0.2	0.5	0.2	0.7	0.7	1.8	3.5	6.0	50.0
	20)	Curtain, Fabrics	0.1	0.0	0.4	0.4	0.5	1.8	5.8	16.0	92.5
	13)	Auto Rentals	0.0	0.1	0.0	0.4	0.3	1.7	7.5	10.0	130.0
	33)	Shoes	0.0	0.0	0.3	0.3	0.8	1.5	6.0	8.5	90.0
	70)	Investments	0.0	0.1	0.0	0.2	0.2	1.5	10.0	8.5	115.0
	19)	Carpets, Floor Covers	0.0	0.0	0.1	0.5	0.6	1.3	8.3	12.5	152.5
	31)	Music Store	0.0	0.0	0.0	0.1	0.6	1.3	6.0	6.0	107.5
	51)	Bowling (and Billiards)	0.1	0.2	0.1	0.4	0.7	1.3	2.0	5.0	42.5
	26)	Books, Stationery	0.0	0.2	0.0	0.2	0.4	1.2	6.0	8.0	35.0
	7)	Health Foods	0.1	0.1	0.1	0.1	0.4	1.1	1.5	1.0	35.0
	78)	Upholster	0.0	0.1	0.2	0.0	0.5	1.1	2.0	7.5	37.5
	42)	Other Retail	0.1	0.4	0.1	0.4	0.5	1.1	9.0	5.0	122.5
	48)	Funeral Parlour	0.0	0.0	0.4	0.3	0.8	1.0	1.5	3.0	11.0
b	89)	Land Developer	0	0.1	0.1	0.2	0.4	0.6	5.0	5.0	127.5
	91)	Carpenter	0	0.5	0.1	0.1	0.1	0.8	3.5	7.0	100.0
	48)	Office Equipment	0	0	0	0.1	0.5	0.9	3.0	21.0	157.5
	68)	Architect	0	0.1	0	0.0	0.2	0.5	3.0	4.5	75.0
	69)	Mortgage/Loan	0	0	0.1	0.1	0.2	0.1	2.5	14.0	325.0
	12)	Car Wash	0	0.1	0.2	0.1	0.3	0.7	2.5	5.0	52.5
	50)	Cinema	0	0.1	0.2	0.3	0.6	0.7	2.5	4.5	32.5
	44)	Department Store	0	0	0.0	0.1	0.4	0.8	2.5	3.5	27.5
	36)	Second Hand Dealer	0	0.1	0.1	0.1	0.6	0.7	2.0	2.5	57.5
	95)	Sand and Gravel	0.1	0.3	0.4	0.5	0.5	0.9	1.5	3.5	57.5
	37)	Motor Cycle	0	0	0.0	0.1	0.3	0.3	1.5	5.0	50.0
	39)	Leather Goods/Luggage	0	0	0	0	0.1	0.7	1.5	4.5	35.0
	79)	Caterer	0	0	0.1	0.1	0.1	0.5	1.0	6.0	135.0
	52)	Electrical Repair	0	0.1	0.1	0.1	0.3	0.5	1.0	2.5	42.5

Figure 4-2

Distribution of Grade 1 to VII Centres in Alberta, 1977


ALBERTA
10 5 0 10 20 30 40 50 Miles
10 0 10 30 50 70 Km
Paved & improved roads
GRADE
I EDMONTON
II RED DEER
III Spruce Grove
IV Ponoka
V Sundre
VI Sangudo
VIIa Lake Louise
VIIb Bk (Hosp Only)
Manning
High Level
50 Miles
70 Km
Ft McMurray
Grimshaw
Peace River
Fairview
Falher
Spirit River
High Prairie
Slave Lake
Beaverlodge
GRANDE PRAIRIE
Valleyview
Swan Hills
Athabasca
Lac la Biche
Fox Creek
Grand Centre
Bonnyville
Westlock
Barrhead
Whitecourt
Mayerthorpe
Sangudo
Legal
Redwater
Smoky Lake
St Paul
Elk Point
Grande Cache
Morinville
Gibbons
Lamont
Two Hills
Onoway
St Albert
Ft Saskatchewan
Winterburn
EDMONTON
Vegreville
Edson
Hinton
Stony Plain
Spruce Grove
SHERWOOD PARK
Tofield
Vermilion
Lloydminster
Devon
Ellerslie
Nisku
Leduc
Drayton Valley
Viking
Millet
Camrose
Wetaskiwin
Daysland
Sedgewick
Wainwright
Jasper
Killam
Forestburg
Rimbey
Ponoka
Bashaw
Bentley
Lacombe
Blackfalds
Stettler
Provost
Rocky Mtn House
Eckville
Sylvan Lake
RED DEER
Castor
Coronation
Consort
Innisfail
Penhold
Bowden
Olds
Sundre
Trochu
Didsbury
Three Hills
Hanna
Carstairs
Drumheller
Crossfield
Airdrie
Oyen
Lake Louise
Banff
Cochrane
Canmore
CALGARY
Strathmore
Bassano
Okotoks
Black Diamond
High River
Brooks
Nanton
Vulcan
Vauxhall
Redcliff
MEDICINE HAT
Claresholm
Picture Butte
Bow Island
Ft Macleod
Coleman
LETHBRIDGE
Coaldale
Taber
(Crows Nest
Blairmore
Pincher Creek
Raymond
Magrath
Cardston
Milk River
Waterton

stores such as hardware and drug stores. More of these centres seem to be located in the less densely populated parts of the province such as Peace River or on the fringes of the Dry Belt.

The 36 Group V centres attain an average population level of 1688 but only add 4 extra specialized retail functions to the set established for Group VI places. Moreover, the number of extra establishments of any type are also very, very low. Most of the towns in this group are located in the shadow of metropolitan centres or are resource towns in low density areas with very limited hinterlands. It will be shown that the population deficiency in these centres is not much higher than those for Group VI places. It is possible that this group is more sensibly classified as a subset of Group VI centres.

The 25 Group IV centres have an average population of 3117 and contain another 26 functions with a new range of specialized retail and professional services. These places are quite widely distributed around the province although with some concentration in particular planning areas.

Group III centres have an average population level of 7926. This is double the previous group size, and 16 more functions become typical activities at this grade. It is worth noting that these are primarily new retail functions.

Group II centres, the regional nodes of Lethbridge, Red Deer, Medicine Hat and Grande Prairie are divided into two subsets on the basis of population, size and the number and range of types of establishment. The two smallest centres have an additional 14 establishments to characterize the grade including a new set of service and professional activities. However, it is the increase in the number of existing establishment types, not new functions that distinguish Lethbridge and Red Deer from the two smaller regional nodes.

The restriction placed upon the number of commercial establishments means that separate functional types for the Group I or metropolitan centres cannot be identified in this study. Instead, Table 4-2 shows that the distinctiveness of the places stems from the very large increase in the numbers of functions of any type.

VI. POPULATION IMBALANCES

A. The General Pattern - Appendix B shows the functional imbalances for all the centres in the commercial analysis in which the places are arranged by hierarchical group. It is apparent that the vast majority of places have a population deficiency since the commercial importance of the centres outweigh the population size of the centre. This is an expected finding given the fact that the centres are service centres for their surrounding regions.

1. Towns with Population Excess - Table 4-4a abstracts the centres with a population "excess" or positive population figure from the larger set of information. Twenty-four centres have population figures greater than their commercial importance would suggest, and another seventeen centres join the group when the township (local) rather than the centre populations are used. These towns can be generalized into two very different groups.

(a) The most important group in terms of size of imbalance consist of the "satellite centres" around the largest places. Sherwood Park and St. Albert around Edmonton have population values greater than 11,000 above their commercial value; the others are quite small. Similar characteristics, although with drastically lower levels, are found in centres adjacent to Lethbridge and Medicine Hat. However, the surprising feature is the low values recorded by places around Calgary.

(b) The second group consists of a set of industrial or resource towns, with Fort McMurray having the highest imbalance with a 1630 population excess. The change in values associated with the township figures for the Crows Nest Pass settlements, Coleman and Bellevue, is particularly noticeable.

(c) The third group of centres is a much more heterogenous set of small towns, primarily in Group 7a and b cagegories. One group has imbalances under 100 population, although it does rise when township figures replace the centre values. The other group has imbalances for township figures. Many of these centres are small towns with a significant local industry, such as Nobleford or Linden, producing higher population figures than the commercial activity would seem to justify; others, such as Granum, are centres which seem to have lost more functions in recent years due to competition with surrounding centres. However, it is worth emphasizing that these imbalances are all quite low.

2. Towns with Population Deficiencies (Table 4-4b) - The majority (1970) of the towns with greater than 15 functions have population deficiencies (given their commercial importance) demonstrating the way in which the places act as regional nodes for the surrounding area.

(a) The largest "deficiencies" are recorded by the metropolitan and regional capitals where three quite separate sets of values can be identified; Calgary and Edmonton have imbalances greater than 70,000, Lethbridge and Red Deer are in the 11-14,000 range, whilst Medicine Hat and Grande Prairie lie in the 3-5,500 category.

(b) The resort centres represent another set of places with higher population deficiencies as can be seen by the figures for the towns in the National Parks--with Banff recording 9,600.

(c) A third group of centres, the larger towns around Calgary are also identified in Table 4-4b since they demonstrate a major difference between the Edmonton-Calgary cases. In the case of Edmonton, it has already been seen that the majority of the centres are true satellites, with populations greater than the commercial activity can justify. Around Calgary it can be seen that with very few exceptions, the centres still have a population deficiency--even when the township population figures are used. To some extent this illustrates the commercialization of these centres "hand in hand" with population influx from Calgary. Yet it is also a product of the continued service centre role of these places as well as their comparatively low population given the proximity and size of Calgary.

(d) For the rest of the centres there are quite wide fluctuations in the degree of population deficiency of the centres. However, there are quite good relationships with the various groups as Table 4-5 shows.

Table 4-4

Population Imbalances in Alberta

a) Urban Centres With Population "Excess"

Numbers represent the population "excess given the functional size of places using the population of the centre. Numbers in brackets are the results using local population figures.

(i) Industrial Residential Satellites

Edmonton -	Sherwood Park	12,193	(12,565)
	St. Albert	11,290	(11,240)
	Spruce Grove	1,762	(1,762)
	Ft. Saskatchewan	1,067	(1,536)
	Bon Accord	198	(716)
	Leduc	-180	(138)*
Calgary -	Black Diamond	386	(613)
	Bragg Creek	141	(374)
	Turner Valley	-146	(88)
Lethbridge -	Raymond	432	(797)
	Magrath	158	(337)
	Coaldale	-497	(254)
Medicine Hat -	Redcliff	924	(997)

(ii) Mainly Resource/Industrial Centres and Small Towns

Fort McMurray	1,630	(1,630)
Grande Cache	460	(507)
Fox Creek	267	(267)
Swan Hills	424	(424)
Bellevue	451	(1,283)
Coleman	229	(1,377)
McClennan	213	(373)
Gibbons	292	(810)
Cowley	90	(125)
Entwistle	53	(309)
Rainbow Lake	54	(60)
Ryley	53	(215)
Nobleford	36	(118)
Penhold	18	(257)
Linden	-407	(118)
Blackfalds	-383	(566)
Delburne	-198	(70)
Alta.Beach	-169	(48)
Berwyn	-168	(18)
Bowden	-165	(95)
Millet	-147	(336)
Tilly	- 82	(217)
Hines Creek	- 76	(28)
Warburg	- 71	(216)
Granum	- 53	(45)
Duchess	- 36	(325)
Sexsmith	- 34	(130)
Champion	- 5	(62)

*Leduc has a population deficiency of -180 given the commercial importance of the centre. When the township, not centre population is used, it has an excess of 138.

b) Urban Centres With Population "Deficiency": Selected Cases

(i) Major Metropolitan Centres

Edmonton	-78,467
Calgary	-79,407

(ii) Major Regional Centres

Lethbridge	-11,688
Red Deer	-14,262

(iii) Minor Regional Centres

Medicine Hat	-3,776
Grande Prairie	-5,574

(v) Towns Around Calgary

Cochrane	-2,340	(-2,036)**
Airdrie	-1,615	(-1,333)
High River	-3,083	(-2,638)
Okotoks	-1,688	(-1,276)
Strathmore	-1,673	(-1,402)
Crossfield	-1,098	(- 840)
Turner Valley	- 146	(- 88)

(v) Resort

Banff	-9,613	
Waterton Park	-1,253	(-1,059)
Jasper	- 458	

** Local or township population in brackets where it can be calculated.

Table 4-5

Average Population Deficiency for Groups

Groups	Average Population Deficiency Using:		
	Centre Population		Local Population
I	76,038	(465,639)*	76,038
IIa	13,263	(39,468)	13,263
IIb	4,766	(25,218)	4,766
III	2,053	(7,926)	1,262
IV	2,468	(3,117)	2,166
V	1,130	(1,688)	904
VI	923	(874)	678
VIIa	433	(629)	186
VIIb	245	(447)	56

* Average populations for the groups are given in brackets.

The averages for the largest places have already been noted, but with the exception of Group III, there are quite large gaps between the average deficiency values. For example, for Group VIIb places the average population is 447 but the average deficiency is 245, whereas for Group V centres the average deficiency is 1130, and the average population is 1688. It is tempting to suggest that for any grade of smaller towns the population of the centre plus the deficiency gives the population of the next level of centre--Table 4-5 shows that there is only a very rough approximation to this idea. In any case, it is worth noting that Group III centres have an average deficiency below those of Group IV centres. This is obviously a function of the population excesses recorded by several places, particularly Sherwood Park and St. Albert. When these places are excluded, the average population deficiency becomes half as high again as the Group IV places.

Although some understanding of the nature of the population imbalances can be derived from those issues already discussed, in the last resort, the imbalance of individual centres can only be explained by reference to the population densities and spatial patterns of competition involved. In other words, the size of the imbalance should be related to the dependent rural population in the trade area of any centre and the size of competing centres. By using the figures for competing centres and maps of population density, an assessment of the local or regional imbalances in particular cases can be made. Space and time constraints obviously mean that these calculations cannot be performed for the multitude of alternative regional areas that could be defined for Alberta. Instead an example of two centres, Taber and Coronation, will illustrate the principles involved.

Taber

1976 Population 5296

(i)	Surrounding Popultation, i.e. in nearest 16 townships (4 x 4) to the town	3296
(ii)	Population "deficiency" from Functional Index - Population Size Comparison	-3248
	Difference	+ 48

Coronation

1976 Population 1198

(i)	Surrounding Population, i.e. in nearest 16 townships (4 x 4) to the town	860
(ii)	Population "deficiency"	-1356
	Difference	- 496

From these two examples it seems that the commercial assessment of Taber as measured by the population deficiency is complemented by the rural population in close proximity to the centre. In the case of Coronation, the population deficiency persists which suggests that the centre has too many functions for its present and rural population - especially given the competition from competing centres such as Castor.

To produce these calculations for all the centres in the area needs very detailed information (township level) on the population distribution in the province - which is not always available on such a small scale for 1976. Moreover, the calculations can be criticized for dealing with a single framework around the centre rather than the trade area population. Nevertheless, it is hoped, in the future, to use the Trade Area maps in Chapter 2 to calculate the population 'excesses' or deficiencies in the trade areas of Alberta.

VII. CONCLUSIONS

This study of the commercial importance of Alberta centres has defined the groups of towns into which the largest 194 centres can be classified. It has established the fact that a hierarchy of functions can be associated with these groups on a province-wide basis and has produced a measurement of the functional imbalance of centres on the basis of the commercial importance - population size relationship. From these results, it is possible to calculate the number of missing or excess functions or establishments for any place by comparing the number of establishments with the average value for the hierarchical group in which the centre is found. Obviously, however, these results must be related back to the particular pattern of functions identified for any place. In this context the source of the information, telephone directories, must be noted.

Appendix A

Technical Definitions and Calculations

(i) Definitions

n = number of different functional (or establishment) types used in the study

T_i = total number of establishments in each functional type or category i

i = any functional type

p = any place or town

Nip = number of establishments of functional type i in town p

Sp = size of population of any town p

A = total population of the area (A) of study, i.e. province

(ii) Measurements or Calculations

Location Coefficients (Li)

Li measures the centrality or central place importance of any one outlet of a functional type i. It weights each outlet according to the relative frequency of occurance of the functional type according to the principle that the fewer the outlets the greater the centrality of each outlet.

$$Li = \frac{1}{100} \, . \, Ti$$

Centrality Value (Cip)

Cip measures the centrality or central place importance of any functional type i in town p. It simply weights the location coefficient by the number of outlets of this type in town p.

$$Cip = Nip\ (li) \quad \text{or } Nip\ \frac{1}{100} \, . \, Ti$$

Functional Index (Fp)

Fp measures the total centrality of any town p. It represents a summary measure of the central place importance of a centre based on the functional complexity of the place.

$$Fp = \overset{n}{\underset{i=1}{}} (Cip)$$

Population Coefficient (Pp)

Pp measures the relative importance of any town p in relation to the total population (A) of the study area.

$$Pp = \frac{Sp}{A} . 100$$

Functional Imbalance (Ip)

Ip measures the extent to which any centre p has relatively more population in study area terms (pp) than is justified by its functional importance as measured by the relative size of the Functional Index (Fp) in the study area.

$$Ip = Pp - \frac{Fp}{n} . 100$$

APPENDIX B

FUNCTIONAL IMBALANCES FOR THE 194 CENTRES

APPENDIX ~~#Z~~ B

FUNCTIONAL [illegible] CALCULATED FOR THE 194 CENTRES

a		321[illegible]00	[illegible]09.[illegible]	-1[illegible]	[illegible]26[illegible]
b	5 [illegible]T. [illegible]TAT	320118.000	164.589	-27[illegible]03	-3776.383
	6 GRN. PRAR	17626.000	104.479	-5574.797	-5713.797
	7 SHERD. PK	26534.000	64.548	12193.530	12565.530
	8 ST. ALBERT	24129.000	57.707	11290.447	12248.447
	9 FT.MACMU.	15424.000	62.088	1630.062	1636.062
	10 LLOYDMIN.	10311.000	60.653	-3164.078	-2926.098
	11 CAMROSE	10104.000	70.939	-5567.553	-5266.563
	12 BROOKS	6339.000	46.699	-4036.057	-3540.057
	13 EDSON	4038.000	38.115	-4429.054	-3101.864
	14 ROCKY MTN.	3432.000	33.288	-3963.565	-3216.565
	15 WHITECOURT	3878.000	27.646	-2264.087	-2010.087
III	16 DRAYTON V.	4303.000	35.639	-3614.700	-2950.700
	17 PEACE R.	4840.000	42.470	-4990.885	-4406.885
	18 HINTON	6731.000	41.125	-2405.621	-2204.621
	19 WETASKIWAN	6754.000	43.529	-2916.744	-2403.744
	20 STETTLER	4182.000	40.600	-4838.005	-4659.005
	21 WESTLOCK	3721.000	38.374	-4604.431	-4550.431
	22 DRUMHELLER	6154.000	39.793	-2686.717	-2199.717
	23 TABER	5290.000	38.461	-3248.837	-2843.837
	24 LEDUC	8578.000	39.421	-100.026	138.974
	25 FORT SASK	8304.000	32.574	1067.005	1536.005
	26 SPRUCE GRV	.007	27.031	-6605.355	1762.628
	27 BANFF	3410.000	50.619	-9613.235	-9613.235
	28 ST. PAUL	4337.000	33.657	-3140.637	-3019.637
	29 HIGH-RIVER	3540.000	30.074	-3083.411	-2638.411
	30 CARDSTON	3043.000	20.743	-1565.511	-1417.511
	31 ATHABASCA	1759.000	20.346	-2761.321	-2452.321
	32 BONNYVILLE	2885.000	27.625	-3252.330	-2850.300
	33 PONOKA	4636.000	36.962	-3575.691	-3230.691
	34 OLDS	3658.000	26.164	-2154.852	-1014.852
	35 VEGREVILLE	4190.000	29.177	-2324.109	-1970.109
	36 WAINWRIGHT	3890.000	25.318	-1734.939	-1553.939
	37 VERMILION	3182.000	20.184	-1302.256	-1123.266
IV	38 FORT MACD.	3067.000	23.425	-2137.235	-1983.235
	39 GRND CENTR	2780.000	25.926	-2979.993	-2979.993
	40 SLAVE L.	3561.000	21.019	-1108.653	-1108.663
	41 VALLEYVIEW	1716.000	19.654	-2650.539	-2295.539
	42 BARRHEAD	2944.000	29.594	-2630.893	-3257.093
	43 INNISFAIL	2097.000	28.505	-3435.944	-2998.944
	44 CLARESHOLM	3276.000	28.084	-2141.193	-2070.153
	45 LACOMBE	3880.000	27.211	-2157.348	-1236.348
	46 SICMY PL.	2717.000	21.244	-2002.730	-1506.700
	47 PINCHER CK	3440.000	26.909	-2508.215	-2241.215
	48 HANNA	2627.000	22.623	-2399.174	-2330.174
	49 HI PRAIRIE	2281.000	21.928	-2568.424	-2153.424
	50 FAIRVIEW	2248.000	20.438	-2292.776	-2092.776
	51 JASPER	3404.000	17.384	-458.214	-458.214
	52 CANMORE	1927.000	17.468	-1553.056	-1420.056
	53 BLAIRMORE	2321.000	18.500	-1790.097	-1569.007
	54 COALDALE	3654.000	18.685	-497.328	254.672
	55 REDWATER	1493.000	12.032	-1180.095	-1005.085
	56 DIDSBURY	2153.000	17.446	-1722.943	-1458.943
	57 NANTON	1152.000	12.683	-1666.298	-1495.298
	58 RAYMOND	2290.000	8.360	432.625	797.625
	59 CARSTAIRS	1059.000	7.610	-633.539	-387.539
	60 GRND CACHE	4116.000	16.455	460.318	507.318

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	[illegible] C[illegible]BIC	1[illegible].000	16.[illegible]	[illegible].[illegible]	-15[illegible]25
	66 [illegible]NVILLE	2097.000	12.280	[illegible].260	-206.260
	67 R.[illegible]EY	1452.000	14.581	-1[illegible].347	-1475.347
	68 COCHRANE	1450.000	17.061	-2340.350	-2036.360
	69 OKOTOKS	1795.000	15.679	-1600.302	-1276.302
	70 SYLVAN L.	1837.000	14.971	-1488.978	-1065.990
	71 NISKU	296.000	9.237	-1754.216	-1754.216
V	72 NAMAO	2253.000	10.647	-112.357	-112.357
	73 HIGH LEVEL	1562.000	12.305	-1171.759	-1095.769
	74 SUNDRE	1099.000	13.157	-1823.991	-1505.981
	75 FOX CRK.	1625.000	6.110	267.463	267.463
	76 CORONATION	1190.000	11.496	-1356.053	-1202.053
	77 SWAN HILLS	2012.000	7.150	423.526	423.526
	78 VULCAN	1412.000	10.919	-2751.170	-2629.170
	79 PROVOST	1532.000	15.632	-1940.032	-1861.632
	80 3 HILLS	1564.000	12.910	-1304.280	-1193.280
	81 CROSSFIELD	777.000	8.442	-1098.519	-840.519
	82 BASSSANO	999.000	8.986	-597.342	-904.342
	83 TOFIELD	1120.000	10.214	-1149.151	-878.151
	84 BOW ISLAND	1296.000	9.018	-885.154	-799.164
	85 ECKVILLE	774.000	9.984	-1444.236	-1041.236
	86 MANNING	1050.000	12.315	-1686.027	-1474.027
	87 GRIMSHAW	1665.000	10.492	-666.100	-381.100
	88 VAUXHALL	954.000	9.776	-1217.926	-938.926
	89 VIKING	1217.000	11.463	-1329.740	-1200.740
	90 OYEN	962.000	10.106	-1283.187	-1238.187
	91 KILLAM	887.000	5.556	-347.292	-221.292
	92 BASHAW	773.000	10.224	-1498.524	-1321.524
	93 CASTOR	1207.000	9.459	-894.600	-757.600
	94 FALHER	1120.000	10.898	-1301.155	-1084.155
	95 MILK RIVER	814.000	10.826	-1591.282	-1460.282
	96 PIC.BUTTE	1164.000	7.740	-555.656	-77.606
	97 BEAVERLODG	1332.000	9.644	-810.551	-540.551
	98 FORESTBURG	808.000	8.088	-988.941	-865.941
	99 THORSBY	657.000	11.234	-1838.623	-1492.823
	100 BENTLEY	730.000	7.827	-1008.941	-748.941
VI	101 LEGAL	874.000	5.256	-293.730	-37.700
	102 ONOWAY	444.000	6.431	-984.874	-548.874
	103 SANGUDO	409.000	5.771	-873.051	-617.051
	104 LAMONT	997.000	7.327	-630.851	-365.861
	105 2 HILLS	943.000	8.787	-1009.242	-888.242
	106 ALIX	669.000	5.613	-577.937	-367.937
	107 ELK POINT	807.000	8.251	-1026.032	-889.032
	108 COLEMAN	1543.000	5.914	229.190	1377.190
	109 SPIRIT R.	1020.000	10.070	-1217.145	-1053.145
	110 MAYERTHORP	1018.000	10.248	-1258.753	-1045.763
	111 SMOKY LK.	925.000	7.664	-777.711	-545.711
	112 TROCHU	752.000	7.355	-882.133	-747.133
	113 DAYSLAND	615.000	8.344	-1238.812	-1069.812
	114 CONSORT	609.000	6.880	-519.617	-805.617
	115 EVANSBURG	671.000	5.461	-542.336	-328.336
	116 SEDGEWICK	825.000	4.625	-202.536	-115.586
	117 [illegible]	888.000	8.803	-889.945	-110.949
	118 ELLERSLIE	804.000	6.630	-669.059	-669.039
	119 BLACK DIAM	1242.000	3.849	386.621	613.821
VII.	120 PENHOLD	773.000	3.390	18.125	257.125
	121 COUTTS	387.000	2.473	-162.408	-102.408

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     122 AN[illegible]      [illegible]6.000     [illegible].303     [illegible]141.[illegible]    -1[illegible].09[illegible]
     123 BLACK[illegible]  [illegible]24.[illegible]     [illegible].336     [illegible]383.[illegible]    [illegible]00.449
     124 MILLET           762.000     4.098     -147.75[illegible]     336.246
II   125 WINTERBRN.       114.000     4.898     -831.564    -831.364
c    126 TURNER V.       1132.000     5.757     -146.914      68.006
     127 CALMAR           872.000     6.197     -504.749    -105.749
     128 BOWDEN           661.000     3.717     -164.756      95.234
     129 WATER PK.        142.000     6.281    -1253.401   -1059.401
     130 L.LOUISE         140.000     2.422     -398.045    -398.045
     131 BOYLE            576.000     5.257     -591.630    -520.630
     132 HARDISTY         534.000     5.018     -758.672    -673.672
     133 CHAMPION         300.000     1.374       -5.199      61.865
     134 MYRNAM           396.000     3.141     -301.913    -161.913
     135 SEXSMITH         770.000     3.622      -34.733     136.267
     136 THORHILD         533.000     4.163     -391.870    -147.890
     137 ANDREW           486.000     3.373     -263.355     -98.355
     138 HOLDEN           393.000     3.312     -342.741    -115.741
     139 HYTHE            460.000     2.974     -200.677     -19.677
     140 WILLINGDOON      308.000     3.180     -390.428    -271.428
     141 LINDEN           296.000     3.167     -407.627     118.373
     142 CARBON           435.000     3.017     -235.214    -126.214
     143 GLENDON          370.000     2.827     -258.031     -72.081
     144 BLACKIE          223.000     2.752     -388.452    -299.452
     145 STANDARD         305.000     2.009     -141.321     -83.321
     146 ROCKYFORD        276.000     2.996     -389.674    -250.674
     147 FOREMOST         534.000     3.305     -217.940    -172.940
     148 WARNER           434.000     2.910     -212.599    -114.599
     149 IRMA             428.000     2.648     -160.231     -65.231
     150 COLD LAKE       1317.000     7.706     -395.134    -395.134
     151 MCCLENNAN       1133.000     4.140      213.274     373.274
     152 MANNVILLE        681.000     4.150     -240.911    -123.911
II   153 BRETON           424.000     3.956     -454.926    -108.926
b    154 MAGRATH         1315.000     5.206      158.394     336.394
     155 HUGHENDEN        236.000     2.464     -311.402    -202.402
     156 WARBURG          408.000     2.157      -71.262     215.738
     157 WASKATENAU       271.000     2.296     -239.014     -59.014
     158 ELNORA           211.000     2.360     -313.207    -174.207
     159 DELBURNE         417.000     2.772     -198.746      70.254
     160 CAROLINE         385.000     3.592     -413.052     -91.052
     161 WILDWOOD         360.000     3.866     -498.845    -249.845
     162 BRUDERHEIM       484.000     4.297     -470.578    -168.578
     163 RYCROFT          535.000     3.089     -597.649    -420.649
     164 NOBLEFORD        417.000     1.715       36.026     118.026
     165 BEISEKER         486.000     4.469     -506.845    -393.845
     166 VILNA            348.000     4.458     -642.405    -456.405
     167 LA CRETE         349.000     3.374     -400.521     -19.521
     168 MARWAYNE         376.000     3.706     -447.357    -285.367
     169 HINES CRK        309.000     2.607      -76.294      27.756
     170 DUCHESS          343.000     1.709      -35.868     325.132
     171 ACME             351.000     4.024     -542.932    -400.932
     172 ENTWHISTL        380.000     1.472       52.953     309.953
     173 RYLEY            432.000     1.706       52.903     214.903
     174 INNISFREE        265.000     2.105     -202.760     -68.760
     175 HOBBEMA           50.000     2.636     -529.684    -458.684
     176 GIBBONS         1093.000     3.602      292.819     810.819
     177 KINUSO           305.000     2.665     -287.010    -240.010
     178 GRANUM           413.000     2.099      -53.355      44.645
     179 ALTA BECH        432.000     2.709     -169.029      47.971
     180 COWLEY           284.000      .869       90.877     124.877
     181 DE WINTON         75.000     1.002     -325.259      -6.269
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185 [illegible]              3?.000          .11?        [illegible]       18?.???
186 [illegible]              3?.000          .7??              .?9?        17?.???
187 B    ER AV.              33.000          .461          -  .110         -69.139
188 BUDD                     30.000          .248          -25.071          50.929
189 CANYFL                   29.000          .165           -7.579          -7.579
190 MILLARVIL                 0.000          .364          -81.324         274.076
191 MIDLEY                    0.000          .222          -45.393          47.607
192 CLOVER BAR                0.000          .957         -212.555           0.000
193 RIV W BANK                0.000          .177          -39.393           0.000
194 POLLOCKVIL                0.000          .580         -128.939           0.000
195 BLUESKY                   0.000          .757         -168.110           0.000
196 FALLIS                    0.000          .828         -183.981           0.000
197 NEWSTOW                   0.000          .347          -77.162           0.000
198 WILLWATER                 0.000          .241          -53.443           0.000
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REFERENCES

Alberta Department of Municipal Affairs (1973), Maps of Trade Areas in Alberta.

Christaller, W. (1933). (Translated by Baskin, C.). "Central Places in S. Germany". Prentice Hall 1966 (Translation).

Davies, W.K.D. and Gyuse, T. (1975). Changes in the Central Place System Around Calgary, 1951-1971, in Barr B. (ed.), Calgary: Metropolitan Structure and Influences. Western Geographical Series II, p. 123-152.

Davies, W.K.D. and Musson, T. (1978). Changes in the Journey to Work Patterns in South Wales 1951-1971. Regional Studies.

Dickinson, R.E. (1956). City, Region and Regionalism. Routledge and Kegan Paul.

Dunn, E.S. (1970). A Flow Network Image of Urban Structures. Urban Studies, 7, p. 239-258.

Huff, D. (1973). The Delimitation of a National System of Planning Regions, Regional Studies, 7, p. 323-329.

Marshall, J.U. (1975). City Size, Economic Diversity and Functional Type: The Canadian Case. Economic Geography, Vol. 51, p. 37-49.

Oldman River Regional Planning Commission (1970), Service Centre Study.

Peace River Regional Planning Commission (1971), Central Place Study.

Pratt, R.T. (1968). An Appraisal of the Minimum Requirements Technique. Economic Geography, 44, p. 117-124.

Pred, A. (1973). Systems of Cities. Lund Studies in Geography, Series B, 38, p. 9-82.

Reilly, W.J. (1931). The Law of Retail Gravitation. N. York.

Red Deer Regional Planning Commission (1976). Service Centre Study.

Royal Commission in Saskatchewan on Agriculture and Rural Life (1957). Service Centres Report No. 12, Regina, Queen's Printer.

Smailes, A.E. (1944). The Urban Hierarchy in England and Wales. Geography, 29, p. 41-51.

Tjorshelm, G. (1972). Central Places in Alberta. Unpublished M.A. Thesis, Department of Sociology, University of Calgary.

Ward, J.H. (1963). "Hierarchical Grouping to Optimize an Objective Function". Journal of the American Statistical Association, 58, p. 236-244.

Wishart (1976). Clustan C. (A suite of Cluster Analysis Procedures). University of London Computing Centre.

CHAPTER 5

REGIONAL VARIATIONS IN THE CHARACTER OF SERVICE CENTRES IN ALBERTA, 1977

I. INTRODUCTION

The system of service centres provides one of the key elements in the human occupance of regions. These centres are the home for the majority of people and by acting as nodal points, provide a locus for the organization of the local space economy. The crucial regional role played by service centres has been recognized by the preparation of a number of service centre reports by the various regional planning authorities in Alberta. Unfortunately these reports cannot be used to provide a province-wide evaluation of the service centre character. Variations in the data used by the various authorities, and in the date of the reports represent obvious difficulties, whilst many of the studies have adopted rather outmoded technical practices to group centres (Davies 1979 Chapter 1 and 3). In addition to these essentially data analysis problems (Davies 1972) many of the service centre studies rely excessively upon the ideas of central place theory. These problems need to be looked at separately.

II. CENTRAL PLACE ISSUES IN REGIONAL PLANNING REPORTS

There is little doubt that central place principles provide a useful conceptual basis for the regional analysis of service centres but it is quite dangerous to directly apply theoretical spacing or ordering sequences to real world examples. The most obvious problem is that many of the assumptions of the theoretical ideas - such as the uniform plain or unrestricted movement - are not relevant in the real world. But, of more significance is the fact that central place ideas only relate to local trade relationships in an area, whereas any real world set of service centres is affected by long distance trade and particularly by the location of industry and non-central service activities. So the theory can only partially represent reality. The theory is further restricted by its failure to incorporate aggregative growth processes, whether they be economies of scale, urban agglomeration economies, or growth pole forces. In theoretical terms all these limitations can be explained away by making certain assumptions and restricting the scope of the central place model. In the real world such problems produce discrepancies between the theoretical and actual patterns of places. Moreover, it must be emphasized that central place theory does not produce a single pattern of places. Even in Christaller's restricted model (Baskin 1962) three very different sequences of centres can be produced using the k = 3, 4 or 7 principles. For example, by restricting a system to five grades of place, the following sequences of numbers of central place can be identified using the 3, 4 and 7 networks respectively: 1, 3, 9, 27 and 81; or 1, 4, 16, 64 and 256, and 1, 7, 49, 343 and 2401. Unfortunately, these alternatives are not recognized in many service centre reports. For example, although the Oldman River Regional Planning Service Centre Report (1970) is careful to describe the restrictions which impede the application of strict central place ideas, (Oldman Report 1970 p. 7) comparisons are still made with one theoretical system (Oldman Report 1970 Table 10, p. 29). No attempt is made to justify why one particular sequence of grades was chosen, and little attention is paid to Losch's (1954) demonstration that a whole range of alternative economic market areas can be identified, each with its own sequence of market centres. Similar examples can be duplicated in other planning reports, but it is in the Peace River report (1971) that the most use is made of Christaller's ideas. Here the expected number of centres based on the k = 3 principle is compared with the real world conditions (Peace River Report 1971, p. 20). Moreover, the sevenfold system identified by Christaller in the Munich region in the 1930's seems to be used to justify the identification of seven grades of place. Such direct comparisons away, a variety of alternative central place systems can be identified and the choice of model needs justification.

The conclusion of this review must be that it is vital to derive the various grades of centre from the data on service centre character rather than imposing the categories upon this information using theoretical ideas that are only partially relevant to the study area. This does not mean, of course, that central place ideas are irrelevant; they provide a useful background body of literature (Berry 1966) which describes the operation of central place ideas under ideal circumstances.

III. OBJECTIVES AND ORGANIZATION

The objective of this study is to build upon previous work on the structure of Alberta service centres (Davies 1979, Davies and Welling 1977) by reviewing the regional variations in the character of service centres using commercial data. The basic question to be answered is whether these centres conform to one single structure in all the regions or whether the structure varies between each area. Given the range of environmental conditions in the province, and the different settlement histories, it is, however, more likely that there will be differences between the various areas. This is not to deny that basic hierarchical structures of service centres can be identified; rather that the number of places at each level or the distribution between levels will vary. The basic goal of this study, therefore, is to investigate the regional variations in the structure of service centres in the province to see if one or several service centre models can be found. If the latter condition prevails the pursuit of different settlement strategies is probably appropriate for each region. This will ensure that the settlements are related both to the environmental character of the various regions and to the alternative, attainable values of the inhabitants of the area. To impose a single structure seems unecessarily authoritarian. Yet, this report is not concerned with policy per se; instead it sets the scene for policy considerations by identifying and describing the character of service centres in Alberta on as rigorous a basis as possible. In this context the same data used in the province-wide classification of places (Davies 1979 Chapter 3) was used, but the study analyses this information according to each of the eight regional planning areas, not on a single province-wide basis. The areas not incorporated into regional planning units were subdivided into two other units, so ten separate analysis were carried out.

Since the conclusions about the differences or otherwise of the sequence of settlements in each regional planning area depend so much upon the classification techniques used, a great deal of attention was paid to the use of different clustering methods. Non-hierarchical cluster procedures (Wishare 1975, Barker 1978) were used in the final solution after exhaustive evaluation of the results of other methods. This represented a technical advance over the hierarchical methods used in the province-wide study. So, together with the breakdown by planning area, two of the three problems posed at the end of the original report (Davies 1979, Chapter 4) were solved. However, since the discussion of the choice of solutions is rather lengthy and detracts from the main theme of regional variations it is placed in an appendix to this chapter (Appendix A). The rest of the report is divided into five sections:

- Data and Techniques
- Identification of Groups of Service Centres
- Comparison between the Regional and Aggregate Analysis
- Characteristics of the Centres
- Variations in the Service Centre Structures

IV. DATA AND TECHNIQUES

The information used in this study consisted of the numbers of establishment for 83 types of commercial functions in 406 centres in Alberta with three or more functions. The data was obtained from the 1977 telephone books since previous work (Davies 1979, Chapter No. 1) showed that this source represented the most accurate information on this data for the province as a whole - short of a personal survey of each node. Instead of treating all centres as a single data set the centres were allocated to ten areas in Alberta. These areas consisted of the eight statutory Regional Planning Areas (Peace River, Edmonton, Battle River, Red Deer, Palliser, Calgary, Oldman, Medicine Hat) and two additional areas called Westlock-Jasper and North East Alberta (Ft. McMurray-Lloydminster) which accounted for the centres not incorporated in a regional planning area. In order to achieve the basic objectives of this Chapter ten separate analysis were carried out to determine the structure of the service centres by planning area. The same Functional Index and Cluster Analysis procedures used in the previous chapter were applied to the data. Information was attained through the use of the non-hierarchical cluster method; the feeling being that individual places may be closer to some other group at higher cluster levels. Therefore the non-hierarchical grouping allows each centre to be allocated to its most similar group at each cluster stage. However, the approach usually uses a hierarchical grouping as a preliminary stage before the final allocation. To ensure comparability with the province-wide hierarchical analysis (Davies 1979 Chapter No. 4) the same euclidean distance measure was chosen as the measure of similarity and the error sum of squares measure (ESS), used in Ward's hierarchical cluster method was used as the grouping procedure (Wishart 1975).

As with all cluster methods the biggest problem consists of the identification of a satisfactory number of groups to interpret. The method adopted here can best be described by reference to an example, Oldman Regional Planning Area. Appendix A shows the groups obtained at a series of cluster levels, from 3 to 10 clusters, in which numercial codes have been given to each cluster. The results of Ward's hierarchical as opposed to the non-hierarchical methods are compared. Appendix A shows the fusion statistics, the error sum of squares in the case of Ward's hierarchical method, and the equivalent sum of similarities in the case of the non-hierarchical method. A major break of slope and change of trend in the distribution of fusion values occurs at the five group level in the hierarchical method and it is usual to cut off at this point. The result, however, is to produce a final group of places in Appendix A ranging from Magrath to Standoff - with numbers of establishments ranging from 56 (Milk River) to 4 (Diamond Creek). The extraction of more groups only marginally reduces the range of this set of places. It would seem that the differences within the groups of larger places are such that the relatively minor variations in the smaller places are overwhelmed. Hence successive hierarchical grouping therefore does not seem particularly useful in differentiating between the smallest places at the elemental level represented by the regional planning units.

In the non-hierarchical approach the array of fusion values shows less marked breaks of slope, instead there is a scree between nine and five groups with a reversal of shape between eight and ten groups that suggests that the nine group solution represents the most satisfactory one to interpret. In terms of substantive results Appendix A shows that the nine group solution is the first occasion at which the smallest places (14 establishments) hive-off to form a separate category, thus splitting the large group of places with less than 40 establishments into two clusters. The combination of these two criteria - the reversals at the bottom of scree slope, and the separation out of the smallest places into a distinct group - provided the most satisfactory way of producing meaningful clusters out of the array of alternative solutions. Beyond the nine group level the larger individual centres crystallize out as independent clusters and relatively small changes in the sum of similarities can be identified - so there is little advantage in picking out more groups. It is, however, worth noting that the move from five clusters produced other differences - apart from the separation of the smallest places. Single centre clusters are associated with: Waterton Park, a specialized tourist centre in a national park; and Vauxhall a rather isolated centre in a sparsely populated region that has not managed to attain the status of places such as Vulcan or Nanton. In addition, Raymond, Magrath, Picture Butte, Coleman and Milk River from another group of centres. Most are close to Lethbridge and all - except the last named - are places that have gained their current status because of the addition of major industrial or natural resource activities rather than purely service centre activities. Therefore, it might be expected that these common economic characteristics would produce a rather distinctive set of centres. Hence, the way the nine group solution sets them apart from the smallest nodes has some utility beyond the obvious considerations based on size. Beyond the nine group level the larger individual centres crystallize out as independent clusters and relatively small changes in the sum of similarities can be identified.

V. GROUPS OF SERVICE CENTRES

One of the obvious problems of comparing the results from separate analysis of regional planning areas is that many areas contain rather different levels of place. For example, it is obvious that Medicine Hat and Oldman do not contain a metropolitan scale centre, whereas the Calgary area has a metropolitan node rather than regional centres. In addition centres that are separated into distinctive groups in the individual analysis - such as Drumheller and Banff in the Calgary region - are part of the province-wide Group III centres in the aggregate analysis. Such problems can be expected; representing the familiar problem of a difference between the elemental - or regional - analysis as opposed to the aggregate - or provincial level study (Berry 1966). Yet overall, the groups at the aggregate level are relatively distinct. Banff and Drumheller for example are more similar to one another than to other centres in the regional planning area; therefore, it is possible to simply portray the divisions between the two centres as sub-groups within the context of the Provincial Grade III group. Although, broad categories of service centre can be recognized in this way it is dangerous to equate the divisions within the groups across the various regional planning areas - given the variations in the relative size of places within each region - unless the grouping has been shown to break into several subgroups. In other words the subgroups within each area relate to the region, not necessarily to the province as a whole; so subgroups (i), (ii) and (iii) in area A, therefore, may overlap with sub-groups (i) and (ii) in area B. The result is that eight categories of centres (I to VIII) are recognized with two grades having major subdivisions called IIa, b, c and VIIa and b. Individual regional planning areas may have large and small centres within these grades that are separated as individual differences at the regional level, resulting in structural patterns that can only be described at the regional level.

VI. COMPARISON BETWEEN THE AGGREGATIVE AND REGIONAL RESULTS

Table 5-1 shows the differences between the membership of the

Table 5-1

Differences Between Provincial and Regional Scale Results

			Changes in Analysis	
Group	Title	Final Total	Regional Non-Hierarchical Changes	
Group I		2		
Group II	Regional	5	Gain	Sherwood Park (3)
Group III	Sub-Regional	20	-	
Group IV	District	25		
Group V	Large Town	31	Loss	Raymond (6) Carstairs (6) Sundre (6) Swain Hills (6) Tofield (6) Namao (7a)
			Gain	Trochu (6)
Group VI	Town	31	Loss	Trochu (5) Mundare (7b) Forestburg (7a) Alix (7b) Evansburg (7a)
			Gain	Raymond (5) Carstairs (5) Sundre (5) Swan Hills (5) Tofield (5) Hardisty (7b) Magrath (7b)
Group VII	Minor Service Centres (a) Specialized	13	Loss	Turner Valley (7b) Evansburg (6) Calmar (7b)
			Gain	Namao (5) Forestburg (6)
	(b) General	80	Loss	Alix (7b) Hardisty (6) Magrath (6) Winfield (8) Niton (8) Wildwood (8) Elnora (8) Hobbema (8)
			Gain	Sixteen centres not in provincial analysis and Turner Valley (7a) Calmar (7b)

groups identified at the provincial level by hierarchical methods when compared to the results obtained by the non-hierarchical approach at the regional planning scale. The biggest difference obviously comes from the incorporation of all places with three or more establishments in the regional scale analysis. This solves the problem of the artificial restriction of the province-wide study to the 194 places with more than fifteen establishments. The replacement by another 'cut-off' value, this time three establishments, is not considered to be an important restriction since it is unlikely that the data source used in this survey - or any other apart from personal survey - can distinguish between places at this size or clearly link a function within a particular node or centre. In other words the data source used in the study is unlikely to give accurate results once one goes beyond this lowest level of place. In general a comparison of the hierarchical and non-hierarchical results over the common set of places in Groups I to VII produced basically similar results. Only 8% of the places change groups and these are almost exclusively between neighbouring levels and in Groups V, VI and VII. The most obvious difference is the addition of Sherwood Park to the Group II or Regional Level Centres. Although this industrial satellite of Edmonton has a population level within the range of the smaller regional centres it is clearly dependent upon Edmonton for a wide range of goods and services and has a very limited hinterland of its own. Nevertheless the satellite has grown to such a size that it is closer to Grande Prairie and Medicine Hat than to other centres in relation to the range of goods and services offered. In total numbers of establishments it is not quite so distinctive with 524 establishments compared to 731 for Grande Prairie and 435 for Lloydminster. Nevertheless, the centre is best treated as a special type of regional level centre - called II - rather than being forced into Group III.

Of the other changes the most important is the loss of six centres from the hierarchical Group V analysis to the Group VI level. All have fewer functions than the norm for the Group V level and are either relatively isolated centres with limited hinterlands or centres subject to a lot of competition from surrounding nodes. Only Trochu is added to the group. At the Group VI level five centres are lost, principally to the VIIb grade while the cluster gains Hardisty and Magrath from the VIIb level and five places from Group V. Three losses from Group VIIa centres are balanced by two additions to the specialized group. At the VIIb level five places are lost to Group VII whereas sixteen centres -- not classified because of the arbitrary number of establishments limit -- are gained.

At first sight such changes between the application of two different methods to the same data set - admittedly at different scales - may cause confusion. However, there are bound to be places that lie in a marginal position between groups and these are likely to show fluctuations when different methods are applied. In the real world absolute differences are rarely found; there are gradations of place. What is important is this set of results, is that the changes have practically no effect upon the functional structure of the hierarchical sequence, between the grades of centres - the individual changes basically balance each other out. Since the non-hierarchical method is intuitively more appealing the final classification of centres is based on this method.

VII. CHARACTERISTICS OF THE CENTRES; FUNCTIONS AND SPATIAL DISTRIBUTIONS

The application of the non-hierarchical clustering methods to service centres in ten regions of Alberta produced eight major groups of places with two groups subdivided into additional categories for descriptive purposes. Each centre is allocated to the group or cluster with which it is most similar. In theory there is no necessity for there to be any pattern in the set of clusters; for the mechanics of the technique used, it is enough that they are different. In practice, however, the various clusters display a hierarchical pattern which is manifested in two ways.

- Firstly, each group is characterized by a set of hierarchical functions, in other words a distinct set of functions that were - on average - found in all the centres at that grade. Initially, a threshold average of 1.0 was used to define which functions were characteristic of each grade but if any function had a modal value above 1.0 this type was included since it has obviously occurred in the majority of the centres. The increase in the number of functions at each grade of place was not, however, regular. Table 5-2 shows that two functions, General Stores and Gas Stations, defined the Grade VIII places followed by seven for Grade VIIIb, one for Grade VIIa and twelve, four, twenty-five, sixteen and fourteen functions for the grades up to Group II. The final grade, Group 1, the metropolitan centres was not characterized

Table 5-2

Hierarchical Sequence of Functions

Group	Number	Functional Type	8	7b	7a	6	5	4	3	2b	2a	1
VIII	8)	Gas Station (& Garage)	1.2	2.1	2.8	3.6	4.7	8.1	15.1	49.5	68.5	1,135.0
	4)	General Store (& Grocery)	1.1	1.9	1.5	2.5	3.3	5.9	8.9	18.8	37.0	357.0
VIIb	46)	Bulk Fuel & Feed		1.9	0.5	3.3	4.4	6.3	6.8	16.0	24.0	42.5
	93)	General Construction		1.2	3.4	1.8	6.5	9.9	27.3	87.5	170.0	1,862.0
	98)	Other Services or Trades		1.1	3.8	1.4	3.4	5.3	17.7	31.5	96.5	1,200.0
	96)	Trucking		1.1	2.4	1.7	4.4	6.0	13.9	48.0	75.3	630.0
	59)	Hotel (& Motel)		1.1	2.4	1.8	2.7	6.5	8.9	22.5	23.0	180.0
	60)	Restaurant (or Cafe)		1.1	1.7	2.0	3.0	6.6	11.0	33.5	46.0	630.0
	62)	Bank		0.8*	0.3	1.6	1.7	2.9	4.7	9.5	12.5	200.0
VIIa	86)	Excavating		0.3	1.3	0.5	1.4	1.9	4.4	10.0	14.5	180.0
VI	76)	Doctor		0.5	0.4	1.6	1.8	4.7	10.2	38.0	69.0	780.0
	65)	Insurance		0.5	0.4	1.6	1.6	4.0	6.5	23.5	44.0	425.0
	55)	Beauty Parlour		0.5	0.8	1.5	1.5	2.8	4.9	17.5	27.0	280.0
	45)	Building Materials		0.7	0.8	1.4	1.6	3.5	4.4	12.5	36.0	105.0
	47)	Farm Equipment		0.7	0.2	1.3	1.6	3.5	5.8	16.0	28.5	190.0
	81)	Plumbing/Heating		0.4	0.4	1.1	1.7	3.4	6.4	20.5	38.0	247.0
	80)	Blacksmith/Welder		0.6	0.5	1.1	2.0	2.9	7.0	15.0	18.8	167.5
	6)	Supermarket		0.3	0.3	1.0	1.1	1.4	2.3	3.8	7.0	52.5
	24)	Liquor/Beer Sales		0.3	0.2	0.9*	0.8	0.9	1.0	1.5	3.0	22.5
	11)	Auto Parts		0.2	0.3	0.9*	1.6	3.4	6.3	17.0	30.0	362.5
	21)	Hardware		0.7	0.7	0.9*	1.5	2.6	3.6	10.8	20.0	160.0
	23)	Drug Store		0.2	0.3	0.9*	1.2	2.4	3.8	8.5	18.5	160.0
V	10)	Auto Sales		0.6	0.1	0.9	1.5	3.1	4.5	20.5	20.5	200.0
	18)	Appliances		0.1	0.2	0.8	1.4	3.0	6.8	26.5	40.5	393.0
	60)	Real Estate		0.3	0.6	0.7	1.5	3.2	6.8	25.5	39.0	685.0
	16)	General Clothing		0.2	0.3	0.6	1.2	2.3	3.1	10.5	13.5	75.0

*Mode is 1.0

Table 5-2

Hierarchical Sequence of Functions

Group	Number	Functional Type	8	7b	7a	6	5	4	3	2b	2a	1
IV	64)	Lawyers		0.0	0.0	0.5	0.9	2.6	4.8	18.0	33.5	728.5
	67)	Accountant		0.1	0.0	0.4	0.8	2.4	4.2	19.0	45.0	347.5
	63)	Credit Union		0.0	0.0	0.3	0.6	1.6	1.8	10.5	3.5	60.0
	56)	Laundry/Dry Cleaning		0.0	0.0	0.3	0.6	1.6	2.2	8.0	11.5	106.0
	30)	Sports		0.1	0.3	0.2	0.7	1.5	3.5	5.5	12.0	122.5
	72)	Dentist		0.0	0.0	0.1	0.2	1.4	3.6	9.5	24.0	265.0
	34)	Mobile Homes		0.1	0.4	0.2	0.6	1.4	2.4	3.0	15.0	65.0
	14)	Men's Clothes		0.1	0.1	0.2	0.4	1.3	1.8	6.0	6.3	100.0
	83)	Misc. Repairs (Shoes,etc.)		0.2	0.3	0.4	0.5	1.3	3.2	9.5	23.0	212.5
	5)	Meat		0.3	0.1	0.5	0.6	1.3	1.9	3.0	9.0	92.5
	27)	Florist		0.0	0.0	0.2	0.7	1.2	1.9	4.5	10.0	
	73)	Vet		0.1	0.1	0.5	0.9	1.2	2.2	4.5	5.0	90.0
	25)	Jeweller		0.1	0.0	0.1	0.4	1.2	2.1	6.0	11.8	113.0
	1)	Bread and Bakery		0.1	0.2	0.3	0.8	1.2	1.2	4.0	7.0	66.5
	74)	Optometrist/Optician		0.0	0.0	0.1	0.4	1.2	2.2	7.5	18.5	135.0
	17)	Furniture		0.1	0.2	0.4	0.5	1.1	2.8	13.0	16.0	102.5
	54)	Barber		0.1	0.1	0.3	0.5	1.1	1.9	7.5	8.0	145.0
	15)	Women's Clothes		0.1	0.2	0.4	0.7	1.1	2.1	8.5	15.0	155.0
	29)	Gifts, Novelties		0.1	0.4	0.1	0.3	1.1	2.9	5.0	9.5	140.0
	75)	Chiropractor		0.0	0.0	0.1	0.5	1.1	2.1	5.5	11.0	90.0
	61)	Auctioneer		0.2	0.1	0.3	0.4	1.1	0.9	2.5	7.0	27.5
	32)	Catalogue Centre		0.0	0.1	0.7	0.7	1.0	0.7	1.0	0.5	11.0
	2)	Confectionary		0.2	0.1	0.4	0.4	1.0	1.9	5.0	9.0	32.5
	28)	Crafts, Hobbies		0.1	0.5	0.1	0.4	1.0	2.1	5.0	14.5	72.5
	87)	Painter/Decorator		0.1	0.1	0.2	0.5	1.0	3.2	16.5	28.3	285.0
	40)	Photographer		0.0	0.0	0.0	0.0	0.7	0.8	16.5	12.5	200.0
III	94)	Cleaning		0.1	0.3	0.1	0.3	0.4	3.1	8.0	24.5	320.0
	77)	Management Cons't		0.0	0.2	0.0	0.2	0.7	2.5	11.0	15.0	167.5
	71)	Travel Agent		0.0	0.0	0.1	0.3	0.8	1.9	5.5	8.0	140.0
	22)	Garden Centre		0.2	0.5	0.2	0.7	0.7	1.8	3.5	6.0	50.0
	20)	Curtains, Fabrics		0.1	0.0	0.4	0.4	0.5	1.8	5.8	16.0	92.5
	13)	Auto, Rentals		0.0	0.1	0.0	0.4	0.3	1.7	7.5	10.0	130.0
	33)	Shoes		0.0	0.0	0.3	0.3	0.8	1.5	6.0	8.5	90.0
	70)	Investments ,		0.0	0.1	0.0	0.2	0.2	1.5	10.0	8.5	115.0

Table 5-2

Hierarchical Sequence of Functions

Group	Number	Functional Type	8	7b	7a	6	5	4	3	2b	2a	1
	19)	Carpets, Floor Covers		0.0	0.0	0.1	0.5	0.6	1.3	8.3	12.5	152.5
	31)	Music Store		0.0	0.0	0.0	0.1	0.6	1.3	6.0	6.0	107.5
	51)	Bowling (& Billiards)		0.1	0.2	0.1	0.4	0.7	1.3	2.0	5.0	42.5
	26)	Books, Stationery		0.0	0.2	0.0	0.2	0.4	1.2	6.0	8.0	55.0
	7)	Health Foods		0.1	0.1	0.1	0.1	0.4	1.1	1.5	1.0	35.0
	78)	Upholsterer		0.0	0.1	0.2	0.0	0.5	1.1	2.0	7.5	87.5
	42)	Other Retail		0.1	0.4	0.1	0.4	0.5	1.1	9.0	5.0	122.5
	58)	Funeral Parlour		0.0	0.0	0.4	0.3	0.8	1.0	1.5	3.0	11.0
IIb	89)	Land Developer		0	0.1	0.1	0.2	0.4	0.6	5.0	5.0	127.5
	91)	Carpenter		0	0.5	0.1	0.1	0.1	0.8	3.5	7.0	100.0
	48)	Office Equipment		0	0	0	0.1	0.5	0.9	3.0	21.0	157.5
	68)	Architect		0	0.1	0	0.0	0.2	0.5	3.0	4.5	75.0
	69)	Mortgage/Loan		0	0	0.1	0.1	0.2	0.1	2.5	14.0	325.0
	12)	Car Wash		0	0.1	0.2	0.1	0.3	0.7	2.5	5.0	52.5
	50)	Cinema		0	0.1	0.2	0.3	0.6	0.7	2.5	4.5	32.5
	44)	Department Store		0	0	0.0	0.1	0.4	0.8	2.5	3.5	27.5
	36)	Second Hand Dealer		0	0.1	0.1	0.1	0.6	0.7	2.0	2.5	57.5
	95)	Sand and Gravel		0.1	0.3	0.4	0.5	0.5	0.9	1.5	3.5	35.0
	37)	Motor Cycle		0	0	0.0	0.1	0.3	0.3	1.5	3.0	60.0
	39)	Leather Goods/Luggage		0	0	0	0	0.1	0.7	1.5	4.5	55.0
	79)	Caterer		0	0	0.1	0.1	0.1	0.5	1.0	6.0	135.0
	52)	Electrical Repair		0	0.1	0.1	0.1	0.3	0.5	1.0	2.5	42.5

by any new functions because of the restriction of the functions to eighty-three commercial types.

- Secondly, all the functions found in the lower order or smaller places are found at the higher orders as well, with the difference that far more numbers of each type occur at the successively higher order. For example, there are, on average, 1.2, 2.1, 2.8, 3.6, 4.7, 8.1, 15.1, 49.5, 68.5 and 1,135 gas stations for each category of place from Groups VIII to Group I. The persistence of this sequence over the whole range of functions is very stiking. Inevitably there are occasional interruptions to the sequence, particularly at the specialized VIIa level where the bank and bulk fuel and feed functions do not attain the average value of 1.0 and cannot be considered to be characteristic of the grade. In addition, construction, trucking, services, and motels are much higher at the VIIa than VI grade, thereby illustrating the specialized nature of this group. Elsewhere, only minor exceptions to the two principles can be found. Rather than dealing with each grade purely in terms of functions each category must be looked at separately so as to identify both the characteristics of the grade and the spatial distribution of the members of the group. Given the emphasis of this study upon the rural service centres only brief summaries are provided on the metropolitan and regional centres.

A. Grade I Centres

Calgary and Edmonton are the two metropolitan or grade centres in the province with an average population of 465,000 at the last census year (1976) although their explosive growth has obviously continued since that time. Forming the core of the settlement system these two centres contain examples of all the functions, but since their population is over ten times the size of their nearest competitor it is not surprising to find similar scales of increase in the average number of functions of each type in Table 5-2.

B. Grade II Centres

The five members of the Grade II or Regional Centres are classified into three sub-groups: Lethbridge and Red Deer with an average population of 39,468 form the highest grade, whereas Medicine Hat and Grande Prairie occupy the next level with an average population of 25,216. Sherwood Park has a population greater than Grande Prairie in 1976 - 26,534 compared to 17,626 - but its position as an industrial satellite of Edmonton means that it has a functional deficiency or population excess of 12,193, rather than the deficiency or functional excess recorded by the other centres. (The concepts of functional excess are explained in Davies, 1979 Chapter 4). Again, however, there are major differences between these regional nodes, for Lethbridge and Red Deer have an average population deficiency or functional excess of 13,263, whereas the value for Medicine Hat and Grande Prairie is only 4,766. This discrepancy reveals the relative weakness of the regional nodality of these two centres which can be attributed to low population densities in their hinterland - a product of the frontier nature of settlement in the Peace River and the low densities associated with the dry belt of South East Alberta. In locational terms three of the five places are some 90-110 miles from each other or from their neighbouring metropolitan centre. The exceptions are obviously Sherwood Park, which is an industrial satellite of Edmonton, and Grande Prairie located in the Peace River area of North West Alberta separated from the continuously settled farming area of Alberta. Hence the settlement pattern of Alberta can be described as being dominated by an approximately linear belt or corridor of high order places from Edmonton to Lethbridge with outlying smaller nodes to the south east of Medicine Hat and to the north west in Grande Prairie. Trends of population and functional growth since 1976 suggests that additional regional level nodes are emerging in Ft. McMurray to the north east and Lloydminster to the east, but at the date of information used in the survey these places were still more closely associated with Grade III centres.

C. Grade III Centres

The twenty Grade III or Sub-Regional centres contain, on an average 301 establishments and almost the whole range of commercial functions with 69 out of 83 functional types having an average value of more than one establishment of this type. Table 5-2 shows that the grade contains sixteen functions which make their first appearance at this level, half of them in specialized retail functions such as footwear, music, stationery and books, health foods, together with highly localized services such as funeral parlours, investment offices and travel agents.

In terms of distribution two rather distinctive spatial patterns can be recognized apart from the concentration of 14 places at this grade in Northern Alberta.

The most widespread consists of two north-south lines of centres approximately parallel to the main corridor of settlement in Alberta.

Most of these centres are some 60-70 miles from one another or from higher grade centres, though these distances are reduced around the regional nodes such as Red Deer and Lethbridge. One line finds representatives in Peace River, Whitecourt, Drayton Valley, Rocky Mountain House, Banff and Crows Nest (the combination of Coleman, Blackmore, Bellevue attains this third order level). The other is associated with Taber, Brooks, Drumheller, Stettler, and Camrose with outliers at Ft. McMurray and Lloydminster.

The second pattern is the cluster of third order centres in the immediate western vicinity of Edmonton, Ft. Saskatchewan, St. Albert, Spruce Grove and Leduc. To the east and south-east Sherwood Park has crystallized out as a low second order node.

The rest of the centres at this level in the province, namely Hinton, Edson and Westlock to the north and west of Edmonton, and Wetaskiwin south of Edmonton, do not conform to a single spatial pattern. It is noteworthy that the Palliser region does not have a representative at this grade because of the low population density of the area.

Within this grade of centres Table 5-1 shows that separate clusters can be identified within the regional planning analyses. The specialization of Banff compared to Drumheller has already been noted, while Camrose is much larger in its functional equipment than Wetaskiwin. However, it is the size of Fort McMurray and Lloydminster that must be noted, places that are close to becoming second grade nodes in the province and seem set to achieve such status with the major natural resource developments in their vicinity. Camrose, although close to this higher level, seems too close to Edmonton to achieve this role - given its local growth potential - unless additional decentralization to the centre from the provincial capital occurs. Among the other centres Banff is obviously a highly specialized centre with a great deal of functional distinctiveness because of its role as an international tourist centre in the National Park, while Drayton Valley is only marginally a member os this third order group because of its limited hinterland population and resource based economy.

The population levels of these centres in 1976 do not display much uniformity, ranging from 24,129 in the residential satellite of St. Albert to Banff's population of 3410. The population node is 6154. This range is considerably reduced when the satellite centres immediately around Edmonton and the incipient regional nodes of Lloydminster and Ft. McMurray are removed from the list. The majority of the smaller places, those in the 3500-4500 range are found in the western line of centres or in the isolated centres where the economy is based on major natural resource development. The sparse hinterland population obviously restricts the growth potential of the service economy of these places, while the restrictions on the population growth of Banff due to national park policy are well known.

Once the relationship between the functional equipment of places is measured by the population equivalent of the Functional Index (Davies 1979 Chapter 4) and the actual population of the places, a rather different picture emerges. The most obvious feature of Table 5-3 is the population excess of the group of centres immediately around Edmonton, demonstrating that their population is greater than their functional equipment would suggest - a simple consequence of a residential satellite population using the higher order node of Edmonton to satisfy many of its need.

For the places with population deficiencies, those in which their functional size is larger than their population would justify, the largest valued are found in a set of centres that do not have competition from higher or next lower order places in at least part of their hinterland. For example, Peace River and Westlock have few competitors to north, while Camrose, Stettler, and Brooks have no serious rival in their hinterlands to the east - in the drier, and more sparsely populated areas of south and central Alberta. By contrast, Taber and Drumheller have Medicine Hat and Hanna on their major access roads to the east. Banff's huge population deficiency has already been explained. The places with lower deficiencies are either in sparsely populated areas in the forested western areas or like Wetaskiwin suffer from a series of competitors in their immediate vicinity. In general, however, most of the Group III centres depend upon their hinterlands rather than on the population of the town alone to support level of services provided. If this hinterland support is not present, the general level of population required to sustain the average functional equipment of the Grade III centre would, on the basis of the modal population and functional index size, be in the order of 8500-9000 people. It may be noted that Leduc, with a population deficiency of -180 for its 8570 population, and a Functional Index of 39.42, is very close to this balanced functional equipment population size level. Similarly, the three Crows Nest Pass Centres - Blairmore, Coleman and Bellevue - have a population deficiency of 1,190 in terms of their functional importance, given their total population of 5,150, which means these

Table 5-3

Characteristics of the Various Grade

[illegible]rade	Number Places	Population (Average)	Functional Index (Average)	Number of Establishments (Average)	Characteristics Functions	Average Population Deficiency
[illegible]	2	465,639	2430.9	17,684	83	76,038
[illegible]Ia	2	39,468	236.1	1,631	83	13,263
b	2	25,218	134.6	925		4,766
[illegible]c	1	26,534	64.5	524		12,193
		(Mode)	(Mode)	(Mode)		
[illegible]II	20	6,154	40.6	269	69	2,053
[illegible]V	25	3,067	25.3	158	51	2,468
[illegible]	31	1,533	12.3	79	25	1,130
[illegible]I	31	825	7.8	48	21	923
VIIa	12	762	4.26	36	8	433
[illegible]IIb	80	394	2.98	22	9	245
VIII	171	N.A.	N.A.	N.A.	2	N.A.

centres are below the average for the Grade III place. Nevertheless, these two examples demonstrate how certain centres with very limited hinterlands are quite close to a balance between functional equipment and population size. To avoid misunderstanding it must be stressed however, that the continued health of most towns requires their continuing role as service centres for their surrounding region, so it is important that their functional equipment is 'surplus' to the town population, or put in another way that their population is 'deficient' vis-a-vis their functions. The concept of the population/function 'balance' is, therefore, a descriptive concept, not one that can be used as a policy goal.

D. Grade IV Centres

The twenty-five Grade IV or District Centres have a modal population size of 3,007 and contain 155 establishments on average. They are identified by fifty-one functions with an average of more than one establishment of the type found in the centres. Half of these functions, twenty-five in all, mark the hierarchical grade since they are not normally found at lower orders of place. It is at this level that the majority of the professional and financial services are found since lawyers, accountants, veterinarians, credit unions, dentists, eye specialists, chiropracters, auctioneers all make their appearance at this level although the first three of these almost identify the Grade V centres since the average value is greater than 0.9. In addition a wide range of retail services are represented by the thirteen additional retail types, in which clothes (men's and women's), furniture, sports goods, jewellers and gifts represent the type of occasional needs often described as shopping goods. Only four service-craft functions are added at this level (laundry, repairs, painter, barber) thereby forming a major contrast to the Grade VI centres.

Figure 5-1 shows that the distribution of these centres does not conform to a simple regional pattern. Apart from a concentration of fifteen of these places in Northern Alberta they are scattered through the area, although series of groups can be recognized. The most obvious, perhaps, is the four centres found around Lethbridge, a circular arrangement which is broken to the east by Taber's growth to a third order place. Similarly Lacombe and Innisfail are located outside Red Deer, although in this case this grade is also represented by Olds and Ponoka to the north and south respectively, forming a unique duplication of centre that may, perhaps be paralleled by the Ft. Macleod - Claresholm dualism on Route 2 north of Lethbridge. In the north, Fairview, Valleyview, High Prairie, Slave Lake, and Athabasca form a broken line of fourth order nodes on the northern

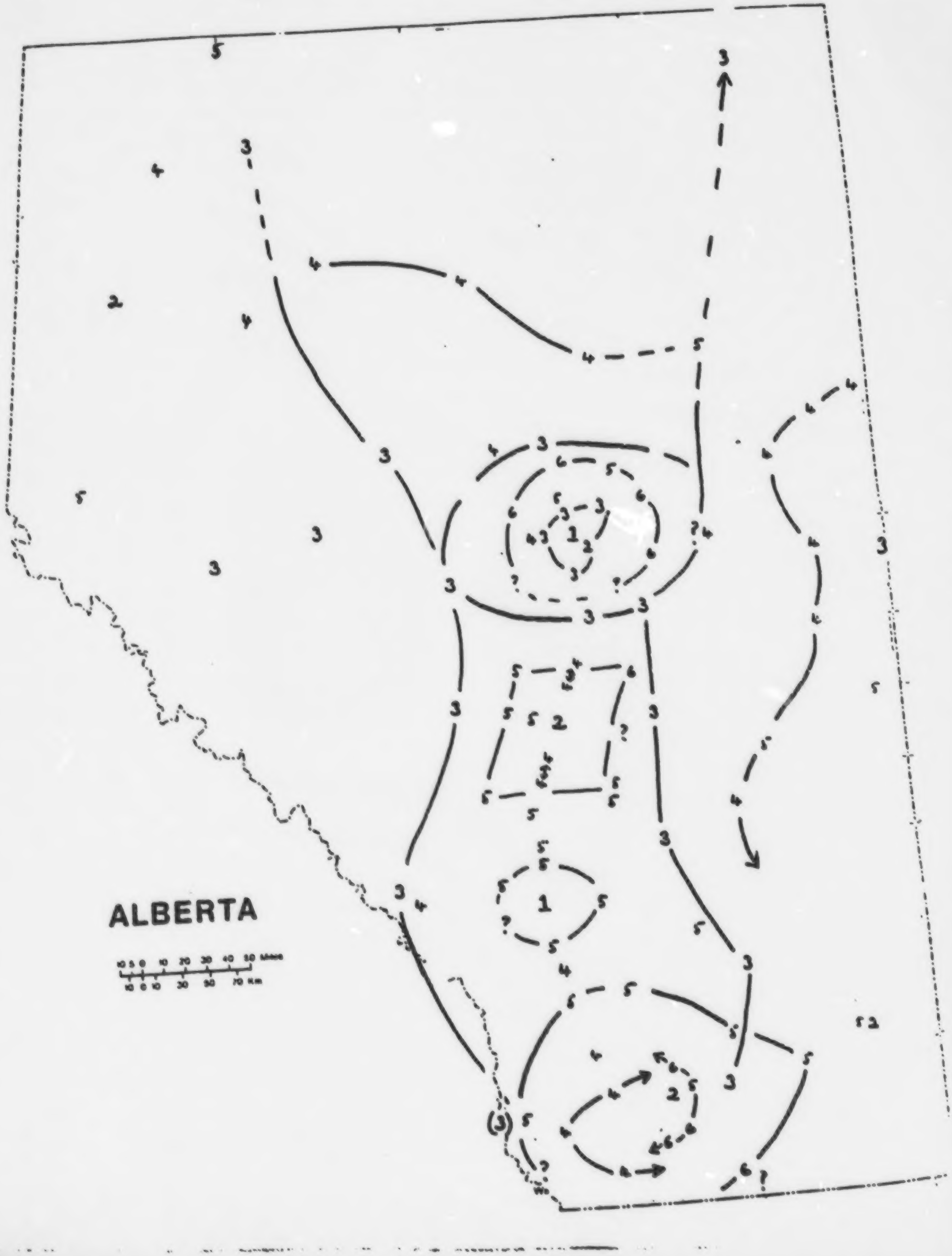

Figure 5-1

Diagramatic Representation of Orders of Centre, 1977

ALBERTA
10 5 0 10 20 30 40 50 Miles
10 0 10 30 50 70 Km

fringes of settlement which is continued in a line of centres surrounding Edmonton - from Bonnyville through Spruce Grove to Vegreville. In the east a north-south trending set of fourth order centres can be identified from Grande Centre, Bonnyville, St. Paul, Vermillion, Wainwright but this peters out into the dry belt at Hanna. In part this eastern belt of centres can be thought of as providing the fourth order equivalent of the other north-south belts of centres recognized at the third and higher grades, although again the fact that the pattern 'disintegrates' in the dry sparsely populated zone of south eastern Alberta must be emphasized. Outside these sets of places isolated examples of this type are found in Jasper, Canmore and High River. The range of population for these centres is much smaller than in previous grades, from 4,636 at Ponoka to 1959 at Athabasca with a mode at 3,067. Again, however, the places with smaller populations are found in the resource centres or fringe of settlement in the north and west of the province. This is a product of the lower hinterland support for these places and explains the comparatively low population of 2,627 in Hanna. In terms of the function: population balance all the centres have population deficiencies, illustrating the continual importance of their service function to these centres. The deficiencies of population have a mode of 2,324 which means that the centres have a level of hinterland support that accounts for almost half of the importance of the places. The result is that the functional equipment of this grade of place as seen in the mode of 25.3 for the Functional Index. This leads to a population equivalent of almost 4,750 for this level of centre.

E. Grade V Centres

Over two-thirds of the thirty-one Grade V places have between 1,000 and 2,000 population, so despite a range from 4,116 (Grande Cache) to 774 (in Eckville) the population mode of the group is 1,533. Table 5-2 shows that twenty-five types of establishment have average values greater than 1.0 and there are 81 establishments in towns at this grade. But compared to other grades the group is relatively indistinct in hierarchical terms. Only four additional establishments first make their appearance in this grade as far as average values are concerned: auto sales, appliance dealers, general clothing, and real estate. However, lawyers and vets, with values of 0.9, are close to being distinctive functions at the level. These characteristics mean that the grade is the weakest hierarchical level of all the groups, except for the specialist VIIa centres. Hence, it can be argued that these centres are closer to being either large Grade VI or small Grade IV places. Since the majority are in the former category the type is called Large Towns. This lack of distinctiveness is confirmed by the values of population deficiency. The average population deficiency or functional excess (Table 5-3) of these centres is 1,130, whereas the sixth and fourth order centres have modal values of 923 and 2,468 respectively. Since the mean and mode values are very similar the pattern that emerges is quite clear; most of the centres seem to perform at a level closer to the Grade VI than the Grade IV places although there are exceptions. For example, the greater functional role played by centres such as Vulcan with a population deficiency or functional excess of 2,791 should be noted.

Over two-thirds of the centres in this group are found in Southern Alberta. The lower average rural densities outside the irrigated areas in the south part of the province and the competition from a number of fourth order centres go a long way to account for this concentration. In distributional terms, four patterns can be identified which account for the majority of places.

- The most obvious is the ring of five fifth order places around both Calgary and Red Deer, although the duplication of centres in close vicinity to one another is noteworthy. Thus, Eckville/Sylvan Lake, Crossfield/Airdrie and Three Hills/Trochu testifies to the very different economies of the centres that led to the growth of two rather than one node at these positions.

- The gaps in the pattern of centres at this level to the west of Calgary and to the east of Red Deer, are explained respectively by the low population densities in the Foothills region, and the competition from centres such as Stettler.

- A third set of places at this level can be identified around Lethbridge, running from Blairmore, through Nanton, Vulcan to Vauxhall and Bow Island. Four centres, Redcliff, Nisku, Devon, Coaldale are nodes located in close proximity to regional or metropolitan centres and represent specialist satellite towns that have attained this level.

- The rest of the centres are scattered throughout the province, but the distribution of these centres reflects the essential weakness of this grade in terms of their functional equipment. Many of the centres are found in frontier or low density areas where the degree of support from rural population is limited - for example Provost, Coronation, Bassano, Manning, High Level, Grande Cache - a feature which also applies to Rimbey or Sundre. Many of the others suffer from their close proximity to higher order places, such as Nanton between High River and Claresholm, or Bow Island between Taber and Medicine Hat, Okotoks between High River and Calgary, or Grimshaw close to Peace River. Moreover, the duplication of centres at this grade is bound to have imparted a restrictive element to the growth of these centres. The conclusion must be that without an additional economic or population boost to these places or their immediate hinterland the centres are likely to stagnate rather than to prosper, since only centres such as Vulcan have a relatively populous hinterland without serious competitors. However, the continued 'spin-off' of population from Calgary to developing satellites, from Cochrane to Airdrie, Strathmore and Okotoks, provides an additional form of support for these nodes which, in time, will boost them to the next grade of centre.

Within the grade a relatively clear dichotomy exists in the hierarchical structure found in most regional planning areas with a distinctive sub-grade associated primarily with those centres having particular difficulties in serving a large enough hinterland population to maintain their role at this grade. This is most obvious in the frontier or relatively sparsely populated areas around Manning, Provost, Coronation, Vauxhall, although some of the dual fifth grade centres such as Three Hills or Eckville are also represented. For Red Deer and Peace River additional groups were recognized because relatively more grades were abstracted in the classification. These subgroups can be easily explained by the presence of specialist functions associated with tourism, as at Sylvan Lake, or places on the fringes of settled areas where centres will accumulate some additional higher order services because of the failure of larger centres to emerge.

F. Grade VI Centres

The thirty-one centres classified in this grade have a population mode of 825, with a relatively restricted range from Coleman (1,543) to Sangudo (409). Two-thirds of these centres are located in the northern part of the province thereby reversing the pattern found at the fifth grade. On average there are forty-nine establishments with twenty-one functions characterizing the grade. Twelve establishment types first make their appearance at this hierarchical level. These new types are rather a mixed group since they include two professional or financial services (doctor, insurance service) six farm or household related sales (building supplies, hardware, farm equipment, auto parts, plumbing, blacksmith) two food and drink outlets (supermarket, beer and liquor store) and two types encompassing health and beauty (drugstore, beauty salon). The grade, therefore, encompasses a fairly complete but unspecialized range of functions so the description Small Town is applied to the grade. The result is that the centres still have a functional excess or population deficiency with a mode of 923 (Table 5-3) demonstrating the approximate balance between the support provided by the population of the centre and the rural population. Most of the places with larger population excesses have access to hinterlands with few competitors - such as Spirit River, Bashaw, Thorsby, Milk River, Oyen and Viking.

In terms of location the group is dominated by three distinctive patterns.

- The first is a northern ring of centres - Legal, Onoway, Thorsby, Tofield, Lamont, Smoky Lake. All except the last named are thirty or forty miles outside Edmonton, located between the two rings of third order centres.

- The second is a set of older industrial satellites located outside Lethbridge, namely Picture Butte, Raymond and Magrath.

- The third is a group of five centres in east central Alberta - Viking, Daysland, Killan, Sedgewick and Hardisty - which demonstrates the inability of a single centre to crystallize out as a major node to dominate the area. However the differences in the population excess of Viking and Daysland, both with values over one thousand compared to Killam (-221), Sedgewick (-115) and Hardisty (-673) demonstrate the greater role played by these two towns. The rest of the centres at that grade are located in the interstices of the trade areas of higher order centres, although the concentration of centres at this grade in Northern Alberta is worth re-emphasizing.

Within each regional planning area the centres at this grade can often be subdivided into two subgroups but it is difficult to make a province wide separation into large or smaller centres. What is noticeable about the grade is the limited number of centres at this level in the short grass belt of south east Alberta. In Palliser, Oyen and Consort are both classified at this level, but there are no representatives from the Medicine Hat area. Given the distances between places it would be expected that Oyen and Consort would be at a higher hierarchical grade; the fact that they are classified at the sixth order illustrates the limited support for service centres available in this low population density hinterland of south east and east central Alberta.

G. Grade VII Centres

Two very distinctive groups of places can be identified at levels below the sixth grade, but the functional differences between them are only sufficient to give subgroup status to the clusters.

- Grade VIIa is a very small and specialized set of twelve centres which are primarily located in close proximity to larger metropolitan and regional centres: Namao, Ardrossan, Ellerslie, Winterburn--and to a lesser extent, Millet--around Edmonton; Blackfalds and Penhold around Red Deer with Bowden further away; Black Diamond near Calgary. Of the others Waterton Park and Lake Louise are obviously specialist tourist centres, while Forestburg is located on the fringe of the group of Grade VI centres in East Central Alberta.

The mode of population in this group is 762 which is close to the value for Grade VI centres. But in functional terms Table 5-3 shows that despite an average number of thirty-four establishments they lack the range of basic service functions, being characterized by only eight different functions. Only one of these types, excavating, is distinctive to the group compared to lower order grades. Banks, as well as the bulk fuel and feed types, are normally absent. The centres, therefore, seem to represent a specialist Grade VII place primarily located in tourist areas or in close proximity to the metropolitan or regional nodes.

- Grade VIIb consists of eighty settlements that are best described as Minor Service Centres since they contain a basic minimum of nine different establishment types, usually a hotel, eating place or restaurant and bank, three service trades such as trucking, general service and construction, and more than one gas station, general store and bulk feed and feed outlet. However in total numbers of establishments the group has an average of twenty-two outlets and a population mode of 394 with an average of 447. The average population deficiency of these places is only 245 and Table 5-3 shows that several settlements with a heritage of industrialization have population excesses.

Centres at this grade are obviously located throughout the province and between one in four or five of the total number of places in the study are found at this level. However in the areas with low rural densities there is a marked absence of centres at this level. For example, in the Palliser region Grade VIIb places are absent and the smallest service centres only attain the Grade VIII level in which the bare minimum functions--gas station and general store--are found. Similarly, only four out of twenty-seven places in the northern-western area from Westlock to Jasper attain this status in a region which is characterized by an economy based on specialized natural resource towns. In the Peace River area half of the centres achieve this status. This relatively large number is a product of the interrelationship between low rural population densities, isolation from the main centres of population and a limited settlement history. These factors ensure that normal forces of economic concentration have not worked themselves out in the region. In Red Deer and Battle River areas fewer places at this level are found; 3 out of 39 and 2 out of 35 respectively. The reason for this anomally seems to lie in the domination of the major north-south belt of settlements in these areas. In the case of Red Deer more of the centres have attained higher order status, whilst in Battle River the larger number of Grade VIII centres seems to be a product of the domination exercised by the larger number of Grade III centres--such as Camrose and Wetaskiwin-- and the duplication of Grade VI towns.

H. Grade VIII Centres

The lowest grade of centre identified in the analysis of the service centres by regional planning area is described as the Hamlet level. Only gas stations and general stores are characteristic of the grade, although the number of establishments ranges from the cut-off value of four to fifteen outlets. Although, low in functional equipment it must be emphasized that a variety of combinations of establishments are associated with the minimum services associated with food and automobile. Hence the smallest service nodes are composed of a miscellaneous group of services out of which has crystallized the type described as Grade VIIb with its cluster of eight characteristic functions.

Although members of this group are shown in Table 5-1 it is worth re-emphasizing that the grade is simply the smallest type of centre. Moreover, the range of functions has been artificially restricted by an arbitrary cut-off value. Places are only shown in Table 5-1 if four or more establishments were found for a named centre. It is quite possible that many local services are not identified in the telephone directory, and there is no guarantee that these services are located in a single cluster of services. Hence the separation of this grade from other places not identified in the survey must not be exaggerated--so differences at this level should not be over-emphasized. In addition, the absence of accurate population figures for these places--some of which may simply be small service nodes along major highways--means that it is impossible to calculate population values.

VIII. VARIATIONS IN THE CENTRAL PLACE STRUCTURES OF THE REGIONAL PLANNING AREAS

Most settlements in Alberta were founded alongside railway lines during the major colonization phase of the province between 1881 and 1910. Pre-existing nodes associated with the fur trade or forts obviously influenced the pattern of settlements and railway, while major additions to the network have been made--especially during the relatively late settlement of the Peace River area and by a series of resource or tourist centres--particularly in the north and west of the province.

Nevertheless, the heritage of the railway period still accounts for the basic spacing of Alberta settlements where stations, and hence incipient service centres, were established some six to eight miles apart. Despite this common foundation the existing structure of service centres in Alberta does not conform to a single model; the growth and decline of settlements has produced quite a variety of different sizes of place within the framework of a hierarchical pattern of functional levels described in the previous section.

In view of this similar pattern of spacing, such variations in the number of places at each level in different areas of Alberta may be rather surprising in theoretical terms. However theories are concerned with ideal conditions in which the usually restrictive premises control the subsequent organization of places. In practice, only glimpses of particular theoretical patterns are found in the real world. Normally, two areas with a common heritage often develop in quite different ways. For example, in terms of the hierarchical sequence found in Alberta two fourth order places may evolve in an area, each with an average of 155 establishments in place of one third order place with an average 301 establishments, or one fifth order centre with 82 establishments, rather than two sixth order places each with 49 functions may exist. In any case the addition of major industrial or natural resource activities to the development of service centres means that growth in many centres is related to national or international trade. So two centres growing up in response to quite divergent growth processes could emerge in close proximity to one another, thereby destroying any uniformity that might be imparted by the influence of threshold and range requirements (Berry 1966) in service centre development.

Figure 5-1 and Table 5-4 summarize the basic variations in the structure of service centres in the various parts of Alberta; the figure by generalizing the spatial patterns and producing a rather abstract representation of the distribution of the larger places; the table by describing the number of centres at each hierarchical grade. As expected, there are few signs of uniformity in the structure of central places throughout the various regions of Alberta. Instead, rather diverse structures have emerged in the various areas and five different patterns can be identified.

Table 5-4

Number of Centres at Each Hierarchical Grade: Regional Planning and Other Areas

					Grades					
Regions	Centres	I	II	III	IV	V	VI	VIIa	VIIb	VIII
1. Oldman*	49	-	1	1	4	5	5	2	10	21
2. Medicine Hat*	19	-	1	1	-	3	-	0	4	10
3. Calgary*	40	1	-	2	2	7	-	2	10	16
4. Red Deer*	39	-	1	2	3	5	3	3	3	19
5. Palliser*	18	-	-	-	1	-	2	-	-	15
6. Edmonton*	45	1	1	5	1	3	5	3	9	17
7. Battle River*	35	-	-	2	1	1	5	2	9	22
8. Peace River*	36	-	1	1	3	4	4	-	16	7
9. North-East	70	-	-	2	6	3	6	-	22	31
10. Westlock-Jasper	27	-	-	4	4	-	1	1	4	13
Totals	378	2	5	20	25	31	31	13	80	171

*Regional Planning Areas

A. Concentration Along Major Corridor Between Edmonton and Lethbridge

The most obvious of these patterns is best seen in Figure 5-1 since the organization of the information into Regional Planning Areas disguises the patterns. This is the concentration of high order places along the major communication corridor of the province between Edmonton and Lethbridge. The major provincial road, Highway 2, cuts off many of the bends associated with the rather more winding railway lines, and by-passes many of the existing settlements on this axis by a few miles. However, if one ignores these relatively modern changes and uses the line of towns along the railway, Table 5-5 shows numbers of settlements found at each grade among the fifty places from Edmonton to Lethbridge.

Table 5-5

Concentration of Higher Order Places Along Major Axis: Edmonton to Lethbridge

Grade	I	II	III	IV	V	VI	VIIa	VIIb	VIII	OTHERS
Number	2	2	2	7	6	1	5	4	4	17

This extreme concentration of high order places can only be fully explained by a historical study, but does seem to be related to the earlier start of this corridor and the additional trade associated with the main provincial routeway as well as 'spin-off' from the major metropolitan and regional settlements. Yet many of these centres experienced additional economic support from the fortuitous location of major natural resource deposits such as oil or gas plants. Perhaps of greater importance, however, is the focus on trade from east and west upon the towns located on this route, as well as the principle of Losch's city-rich sector idea (Losch 1955) in which alternative town locations are concentrated in transportation corridors. The Juxtaposition of a series of such city-rich zones around metropolitan and regional centres would produce a zone of higher status places.

B. Concentration Around Metropolitan and Regional Nodes

The second major pattern is the greater concentration of higher order places around the metropolitan and regional nodes. Again it can be expected from Isard's modification of central place ideas (Isard 1960) that higher levels of commercial specialization will be found around the larger centres, in part a product of the growth of industrial and residential satellites. Nevertheless the extent to which this has occurred around some Alberta centres and the variations between the patterns found around these nodes is quite striking.

1. The greatest degree of complexity is associated with Edmonton, which has developed into a classic city-regional structure of metropolitan centre surrounded by specialized satellite towns. Four VIIa or Specialized Minor Service Centres lie within ten miles of the city, and within twenty miles there is a ring of third order centres - Ft. Saskatchewan, St. Albert, Spruce Grove and Leduc. This pattern is, however, interrupted on the east where commercial activity in Sherwood Park has grown large enough for it to be classified as a Grade II place. Approximately thirty miles from Edmonton is a set of sixth order places. Again variations are found, this time by the development of Redwater, in the north, to fifth order status, and the gap in this sequence in the south and south east where severe competition to any emerging service centre is provided by the two third order nodes of Camrose and Wetaskiwin. These two places form the southern representatives of the fourth ring, or rather semi-circle of third order centres. Again, the continuity of this arrangement is broken to the north east and east, where Vegreville only achieves fourth order status--presumably because of competition from the similar sized Vermilion to the east--and from the inability of any centre in the north west to attain subregional or even district status. At the same forty to sixty miles distance from Edmonton are a number of VIIb centres, while scattered representatives of higher grades can also be found throughout the area.

2. The specialization of centres around Red Deer is very much linked to the differentiation along the major north-south routeway in the province. Two VIIa centres and a pair of fourth order places to the north and the south of the city, namely Ponoka and Lacombe, and Innisfail and Olds are found. However, in addition, an oblong-like arrangement of fifth order places around Red Deer can be identified. This pattern is broken to the north east by the inability of Bashaw to grow beyond the sixth order, presumably due to the competition from third order Stettler which inhibits the growth of even town level centres in the east.

3. Although Calgary is a metropolitan centre, its hinterland

remains relatively simple in service centre structures, except in the south west, in the vicinity of the Turner Valley oil and gas field, where a set of different sized places can be identified and High River attains fourth order status. Apart from this, the only differentiation consists of a ring of fifth order centres from Cochrane to Okotoks, but the continuity of even this pattern is broken by the absence of a south western representative in the low density foothills area. The simplicity of Calgary's metropolitan pattern is a function of its development as an office based and therefore centralized centre, although, the rapid suburbanization of the city has, in the last decade, begun to turn the surrounding rural service centres into residential satellites. The continuation of this growth is likely to mean that the city will be surrounded by a set of fourth order nodes.

4. In many ways Lethbridge is the southern equivalent of Edmonton because it is also surrounded by a series of very different sized centres--albeit at a lower order--but here the patterns are much more fragmented. From the north east to the south are much more fragmented. From the north east to the south are four settlements that owe their fourth and fifth order status to service functions originally following industrialization, and now, perhaps to residential decentralization. To the west are a set of fourth order nodes, from Claresholm to Cardston, each associated with different urbanizing influences--a pattern that was continued by Taber in the east until it achieved higher status. Some forty to sixty miles outside this zone lies a series of fifth order centres, but the effect of the U.S. border and the lower density of population to the south and south east of Lethbridge has meant that no representatives of this order are found in this zone.

The regional centres outside this belt of concentrated settlement have already been shown to be much weaker in status and, except for Redcliff outside Medicine Hat, they do not have satellite centres or rings of higher order nodes.

C. Concentration Along Major Roadways

The concentration of places at the town and minor service centre grade along the major routeways in the province, when compared to the minor roads, represents a third major pattern. One of the best examples of this trend can be seen around Calgary where the major roads out of the city have far more higher order places; in the areas between these roads the service centres are at a much lower order. Perhaps the sector occupied by Highway 9 and 21 to Trochu and Three Hills provides a partial contradiction to this general theme but even here the duplication of VIIb centres contrasts with the fifth and sixth grade nodes along Highway 2. This pattern can also be illustrated by comparing the status of centres along five seventy mile stretches of railway in southern Alberta, ranging from Highway 2 eastwards into the area of short grass prairie (Table 5-6). Although, there are slightly more places in the western examples the difference is not as striking as the variation in the sequence of places. All sections of the route have the same number of fifth order places, but the Ft. Macleod to Aldersyde section has three fourth order nodes, whereas the Bassano-Majestic area only has one other centre at or above the Minor Service Centre status. Between these extremes a major difference is seen between the Nobleford and Vauxhall examples where the former has four VIIb centres, whereas in the latter only eighth order places are found. In this latter example the rail route was not followed by a road and it demonstrates the vital role played by the type of communication link, rather than initial spacing, in the development of service centres. In the Suffield-Bassano example the focus of the limited trade of this sparsely populated area upon the Trans-Canada link provides a larger number of higher order centres than is typical of the region.

D. Lack of Higher Order Places in Low Density Farming Areas

The fourth major pattern in the province is associated with the inability of the low density farming areas to generate higher order places. This has already been illustrated in the previous section, but can be clearly seen in Table 5-6a where the number of places along a series of west-east and north-west to south-east trending road and rail routes in the areas east of Edmonton are shown. This zone is not yet incorporated into any regional planning area. Although third order places are found on most routes, demonstrating that relatively large nodes are found in all areas, in the St. Paul and Vermilion areas there are relatively more fourth order places. But by the Hardisty area the fourth order centres generally diminish and only sixth and eighth order nodes are present (Table 5-6b). Even these soon degenerate to sequences where only a few sixth order places relieve the pattern of eighth order centres and no seventh order places survive. The consequence of these trends is seen in the number of places at each hierarchical level in the Palliser and Medicine Hat regions (Table 5-5) where there are very few centres above the Grade IV level. For example, in Palliser area only Oyen reaches this grade. Similarly, these regions

Table 5-6

Service Centre Variations Along Selected Routes

a) North-South Routes in Southern Alberta

Places in approx. 70 mile sequence	Number of Centres	3	4	5	6	7a	b	8	Others
Ft. Macleod-Nanton-Aldersyde	13	-	3	1	-	-	2	-	7
Nobleford-Vulcan-Aldersyde	13	-	-	1	-	-	4	1	7
Vauxhall-Lomond-Arrowwood	10	-	-	1	-	-	-	3	6
Suffield-Brooks-Bassano	10	1	-	1	-	-	1	-	7

b) East-West Routes in East Central Alberta

Places in approx. 120 mile sequences to Sask. border	Number of Centres	3	4	5	6	7a	b	8	Others
Lamont-Vermillion-Lloydminster	16	1	2	-	1	-	4	5	3
Tofield-Chauvin	16	-	1	-	2	-	4	4	5
Camrose-Hardisty-Hayter	17	1	-	1	5	-	1	5	4
Stettler-Compeer	18	1	-	1	2	-	-	7	7
Drumheller-Sibbald	20	1	1	-	1	-	-	4	13
Gleichen-Empress	17	-	-	1	-	-	1	4	11

have fewer Grade V or Grade VI places, and the Palliser Region does not have representatives of the Minor Service Centre or VIIb grade; only Grade VIII places struggle to maintain some viability.

Yet population density alone is not the only factor at work in accounting for these trends; it is the presence of a low density farming population that explains these characteristics. Where resource towns have been built in the foothills and forest regions west of Edmonton there are higher concentrations of medium level places (Grade III and IV) because the type of large scale resource exploitation in the area has produced sizeable free-standing centres. Hence the Westlock-Jasper area has relatively more higher grade places, and few in the town or minor service centre categories represented by Grades V to VIIa.

E. Regional Differences in Hierarchical Service Structure

Table 5-5 also shows that those areas that are more remote from the large metropolitan centres have rather different structures. In Peace River there are almost fifty percent more fifth and sixth order places than for the province as a whole and almost twice as many VIIb centres. This illustrates the higher level of localization in the service structure of Peace River region. Again, perhaps, remoteness alone is not the only factor at work. The differential structure may also be associated with the relative weakness of Grande Prairie as a regional node, and the fact that settlement in the area is of much more recent origin and has not, therefore, been exposed to such a long period of centralization as the rest of Alberta.

IX. CONCLUSION

This Chapter has attempted to set the scene for the evaluation of planning policy in relation to service centres in Alberta by identifying the structure of service centres throughout the province. Non-hierarchical cluster techniques were applied to a range of commercial functions to group centres on the basis of their similarity within each of ten different regions in the province. Although a basic hierarchical structure was identified the variations in the pattern of service centres in Alberta demonstrates that the spatial arrangement of places does not conform to a single model. The number and size of places varies considerably from area to area. This does not mean that the sequence of centres in any part of the province is a chaotic one; particular patterns can be identified--many of which can be linked to the domination of particular processes of change in the various areas. As in most real world examples the urban system or set of places is built-up from a series of different urbanizing influences that are likely to be unequal in their spatial impact and which overlap with one another to produce a complex mosaic of centres. In Alberta there seems little doubt that the most common element of support through the region is the rural service centre function, but this does not necessarily lead to a uniform pattern of places. It has been shown that variations in the underlying rural density and in the isolation of areas produce rather different responses in terms of the numbers of place at each hierarchical level. The addition of centres based primarily upon the exploitation of such local natural resource or an industry provides another source of differential impact throughout the region. When this phase of exploitation is finished the centres revert back to a service centre role.

Also, the development of centres around the major metropolitan and regional nodes, and along the major routeway in the province, impart further elements of variation in the province--producing a rather distinctive pattern of places. Such variations mean that it is difficult to accept that a single, uniform approach to the development of service centres in Alberta can produce acceptable results. Even if one is prepared to ignore local feeling, and discount the differences in the values and preferences held by regional planning authorities and commissions, the background variations in the number and size of service centres in each area must be taken into account. Since these structures vary from area to area they are bound to produce an element of uniqueness which can be complemented by the influence of local choice. In this way the development of service centres in any region will be derived from, rather than imposed upon, the existing pattern of places. Although, this report has attempted to set the scene for the evaluation of planning policy for service centres the restriction of the study to commercial functions must be noted. Ideally, the study should be complemented by an analysis of the variations in social and governmental functions throughout the towns of the region since these provide important elements of support in the functioning of service centres.

Appendix A

Example of Cluster Sequences: Oldman Regional Planning Area

Places	Establishments	Non-Hierarchical								Hierarchical								Ranking By RPP	Final Banking
		10	9	8	7	6	5	4	3	10	9	8	7	6	5	4	3		
1. Lethbridge	1758	7	7	7	7	7	7	7	7	1	1	1	1	1	1	1	1	C	II
2. Taber	248	10	10	10	10	10	10	10	3	2	2	2	2	2	2	2	2	GT	III
3. Pincher Creek	159	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	GT	IV
5. Claresholm	165	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	GT	IV
6. Cardston	142	3	3	3	3	3	3	3	3	6	3	3	3	3	3	3	2	GT	IV
7. Ft. Macleod	152	3	3	3	3	3	3	3	3	7	7	7	7	3	3	3	2	GT	IV
4. Blairmore	119	9	9	3	9	9	9	3	3	4	4	4	4	4	4	3	2	T	Va
8. Coaldale	110	9	9	9	9	9	9	3	3	4	4	4	4	4	4	3	2	T	Va
12. Vulcan	103	9	9	9	9	9	9	3	3	9	9	4	4	4	4	3	2	GT	Va
10. Nanton	82	9	9	9	9	9	9	3	3	9	9	4	4	4	4	3	2	T	Va
11. Vauxhall	66	11	11	11	4	4	9	3	1	9	9	4	4	4	4	3	2	T	Vb
9. Raymond	61	4	4	4	4	9	9	3	1	9	9	4	4	4	4	3	2	T	VI
13. Magrath	35	4	4	4	4	4	1	1	1	13	13	13	6	5	5	5	5	T	VI
16. Picture Butte	48	4	4	4	4	4	1	1	1	13	13	13	6	5	5	5	5	T	VI
18. Milk River	56	4	4	4	4	4	1	1	1	13	13	13	6	5	5	5	5	T	VI
19. Waterton Park	40	19	19	19	19	4	1	1	1	19	19	19	19	19	5	5	5	-	VIIa
15. Coleman	42	8	4	4	4	4	1	1	1	13	13	13	6	5	5	5	5	T	VI
14. Champion	19	1	1	1	1	1	1	1	1	13	13	13	6	5	5	5	5	V	VIIb
17. Warner	21	1	1	1	1	1	1	1	1	13	13	13	6	5	5	5	5	V	VIIb
20. Coutts	23	1	1	1	1	1	1	1	1	20	20	20	6	5	5	5	5	V	VIIb
21. Granum	18	1	1	1	1	1	1	1	1	20	20	20	6	5	5	5	5	?	VIIb
22. Nobleford	19	1	1	1	1	1	1	1	1	13	13	13	6	5	5	5	5	V	VIIb
25. Barons	15	1	1	1	1	1	1	1	1	20	20	20	6	5	5	5	5	V	VIIb
28. Stavely	23	1	1	1	1	1	1	1	1	20	20	20	6	5	5	5	5	?	VIIb
29. Cowley	17	1	1	1	1	1	1	1	1	20	20	20	6	5	5	5	5	V	VIIb
30. Lundbreck	12	1	1	1	1	1	1	1	1	20	20	20	6	5	5	5	5	-	VIIb
36. Bellevue	23	1	1	1	1	1	1	1	1	20	20	20	6	5	5	5	5	V	VIIb
42. Stirling	12	1	1	1	1	1	1	1	1	20	20	20	6	5	5	5	5	V	VIIb
23. Grassy Lake	8	6	6	1	1	1	1	1	1	20	20	20	6	5	5	5	5	V	VIII
24. Lomond	14	6	6	1	1	1	1	1	1	20	20	20	6	5	5	5	5	V	VIII
26. Shaughnessy	11	6	6	1	1	1	1	1	1	20	20	20	6	5	5	5	5	-	VIII
27. Coalhurst	6	6	6	1	1	1	1	1	1	20	20	20	6	5	5	5	5	-	etc.
31. Carmangay	11	6	6	1	1	1	1	1	1	20	20	20	6	5	5	5	5	V	
32. Glenwood	5	6	6	1	1	1	1	1	1	20	20	20	6	5	5	5	5	V	
33. Hays	6	6	6	1	1	1	1	1	1	20	20	20	6	5	5	5	5	-	
34. Barnwell	7	6	6	1	1	1	1	1	1	20	20	20	6	5	5	5	5	-	

Appendix A

Example of Cluster Sequences: Oldman Regional Planning Area

Places	Establishments	Non-Hierarchical								Hierarchical								Ranking By RPP	Final Banking
		10	9	8	7	6	5	4	3	10	9	8	7	6	5	4	3		
35. Arrowwood	11	6	6	1	1	1	1	1	1	20	20	20	6	5	5	5	5	V	VIII
37. Hillcrest	9	6	6	1	1	1	1	1	1	20	20	20	6	5	5	5	5	-	etc.
38. Spring Coulee	4	6	6	1	1	1	1	1	1	20	20	20	6	5	5	5	5	-	
39. Diamond Creek	4	6	6	1	1	1	1	1	1	20	20	20	6	5	5	5	5	-	
40. Wrentham	6	6	6	1	1	1	1	1	1	20	20	20	6	5	5	5	5	-	
41. Pincher Creek	5	6	6	1	1	1	1	1	1	20	20	20	6	5	5	5	5	-	
43. Turin	4	6	6	1	1	1	1	1	1	20	20	20	6	5	5	5	5	-	
44. Iron Spring	7	6	6	1	1	1	1	1	1	20	20	20	6	5	5	5	5	-	
45. Mountain View	5	6	6	1	1	1	1	1	1	20	20	20	6	5	5	5	5	-	
46. Hill Spring	6	6	6	1	1	1	1	1	1	20	20	20	6	5	5	5	5	V	
47. Frank	10	6	6	1	1	1	1	1	1	20	20	20	6	5	5	5	5	V	
48. Milo	8	6	6	1	1	1	1	1	1	20	20	20	6	5	5	5	5	V	
49. Standoff	9	6	6	1	1	1	1	1	1	20	20	20	6	5	5	5	5	-	
New Code at the Group		8	6	12	11	4	9	10	3	6	13	17	7	19	4	3	5		

Numbers refer to the cluster code for each group, e.g. Taber, Code 10, is the only member of this group at the fifth Non-Hierarchical Grouping Stage whereas there are four members of the group labelled Code 3.

(Banking by "RPP" - "RPP" stands for Regional Planning Report)

Cluster Diagnostics: Oldman River Area

	Non-Hierarchical		Hierarchical	
	Sum of Similarities	Difference	Error Sum, Squares	Difference
12	25.2	0.9	1.9	0.1
11	26.1	1.0	2.0	0.0
10	27.1	1.2	2.0	0.4
9	28.3	1.3	2.4	0.3
8	29.6	2.2	2.7	0.2
7	31.8	3.4	2.9	0.1
6	35.2	3.9	3.0	0.3
5	38.1	6.5	3.3	4.7
4	44.6	14.2	8.0	6.9
3	58.8	74.0	14.9	48.9
2	122.8	1827.2	63.8	1886.7
1	1950.0		1950.5	

(a) Medicine Hat Regional Planning Area: Groups

Places	Establishments	Hierarchical	Reg. Plan	Non-Hierarchical Grades			
				7	6	5	4
1 Medicine Hat	1120	2b	1	8	8	8	8
2 Brooks	336	3	2	7	7	7	7
3 Bow Island	69	5	3	4	4	4	4
4 Bassano	63	5	3	4	4	4	4
5 Redcliffe	74	5	3	4	4	4	4
6 Foremost	28	7b	3	9	9	9	1
7 Tilly	20	7b	4	5	1	1	1
9 Duchess	16	7b	4	5	1	1	1
8 Irvine	17	7b	4	1	1	1	1
10 Rosemary	9		4	5	2	1	1
11 Burdett	8		4	2	2	1	1
12 Etzikom	5		5	2	2	1	1
13 Dunmore	3		5	2	2	1	1
14 Hilda	5		5	2	2	1	1
15 Manyberrys	4		5	2	2	1	1
16 Elkwater	3		5	2	2	1	1
17 Seven Persons	5		5	2	2	1	1
18 Rolling Hills	6		5	2	2	1	1
19 Ralston	5		5	2	2	1	1
*Chosen Solution				*			

(b) Non-Hierarchical Grouping Statistics: Medicine Hat

Grouping Stage	Value	Difference
12	4.7	0.2
11	4.9	0.1
10	5.0	0.1
9	5.1	0.3
8	5.4	0.7
7	6.1	0.8
* 6	6.9	0.3
5	7.2	1.2
4	8.4	7.7
3	16.1	82.3
2	98.4	673.1
1	771.5	

(a) Calgary Regional Planning Area: Groups - (and Banff National Park)

Places	Establishments	Hierarchical	Regional Plan	Non-Hierarchical Grades								
				11	10	9	8	7	6	5	4	3
1 Calgary	17,239	1	7	3	3	3	3	3	3	3	3	3
2 Banff	314	3a	-	4	4	4	4	4	4	4	4	4
3 Drumheller	265	3a	6	5	5	5	5	5	5	5	5	5
5 High River	180	4	6	12	12	12	12	12	5	5	5	1
4 Canmore	124	4	5	8	8	8	8	8	8	5	5	1
6 Strathmore	102	5	5	9	9	9	9	9	9	9	5	1
7 Airdrie	92	5	5	9	9	9	9	9	9	9	5	1
9 Cochrane	113	5	6	9	9	9	9	9	9	9	5	1
8 Crossfield	64	5	5	9	9	9	9	9	9	9	1	1
10 Okotoks	94	5	5	10	10	10	10	9	9	9	1	1
11 Three Hills	79	5	6	10	10	10	10	9	9	9	1	1
12 Trochu	51	6	6	10	10	10	10	1	1	1	1	1
13 Black Diamond	38	7a	5	1	1	1	1	1	1	1	1	1
18 Lake Louise	19	7a	-	1	1	1	1	1	1	1	1	1
14 Turner Valley	36	7a	5	6	6	6	1	1	1	1	1	1
15 Bragg Creek	18	7b	-	6	6	6	1	1	1	1	1	1
16 Dewinton	16	7b	-	6	6	6	1	1	1	1	1	1
19 Beiseker	34	7b	5	7	6	6	1	1	1	1	1	1
20 Linden	24	7b	5	7	6	6	1	1	1	1	1	1
21 Acme	25	7b	5	6	6	6	1	1	1	1	1	1
22 Carbon	22	7b	5	7	6	6	1	1	1	1	1	1
23 Standard	16	7b	5	7	6	6	1	1	1	1	1	1
24 Blackie	17	7b	5	7	6	6	1	1	1	1	1	1
25 Rockyford	22	7b	5	7	6	6	1	1	1	1	1	1
17 Longview	14		3	11	11	6	1	1	1	1	1	1
26 Gleichen	12		5	11	11	6	1	1	1	1	1	1
27 Nacmine	3		3	11	11	6	1	1	1	1	1	1
28 Cluny	5		5	11	11	6	1	1	1	1	1	1
29 Langdon	6		-	11	11	6	1	1	1	1	1	1
30 Swalwell	3		-	11	11	6	1	1	1	1	1	1
31 Torrington	9		3	11	11	6	1	1	1	1	1	1
32 Hussar	10		5	11	11	6	1	1	1	1	1	1
33 Carseland	7		-	11	11	6	1	1	1	1	1	1
34 East Coulee	3		-	11	11	6	1	1	1	1	1	1
35 Madden	3		-	11	11	6	1	1	1	1	1	1
36 Wimbourne	5		3	11	11	6	1	1	1	1	1	1
37 Millarville	6		-	11	11	6	1	1	1	1	1	1
38 Irricana	13		5	11	11	6	1	1	1	1	1	1
39 Exshaw	4		-	11	11	6	1	1	1	1	1	1
40 Huxley	3		-	11	11	6	1	1	1	1	1	1
						*						

Rank by Regional Planning Report.
* 7 Greater than 51 high order firms.
6 Greater than 6-50 high order firms.
5 Greater than 1-5 high order firms.
4 Greater than 6 or more middle order firms.
3 Greater than 1-5 middle order firms.
2 Greater than 6 or more low order firms.
1 Greater than 1-5 low order firms.
More places are shown in the Regional Planning Report than are listed here.
* Chosen Solution

(b) Non-Hierarchical Grouping Statistics: Red Deer Area

Grouping Stage	Value	Difference
12	28.9	0.4
11	29.3	1.4
*10	30.7	0.7
9	31.4	1.9
8	33.3	1.3
7	34.6	3.2
6	37.8	2.3
5	40.1	6.5
4	47.6	11.5
3	59.1	83.8
2	132.9	1657.1
1	1789.0	

(a) Battle River Regional Planning Area: Groups

Places	Establishments	Hierarchical	Regional Plan	Non-Hierarchical Grades 10	9	8	7	6	5	4	3
1 Camrose	425	3	1	2	2	2	2	2	2	2	2
2 Wetaskiwin	285	3	1	10	10	10	10	10	10	10	2
3 Ponoka	196	4	1	12	12	12	12	12	12	12	12
4 Rimbey	92	5	2	6	6	6	6	6	4	12	12
5 Hardisty	35	6(7b)	2	4	4	4	4	4	4	1	1
6 Killam	46	6	2	4	4	4	4	4	4	1	1
7 Sedgewick	37	6	2	4	4	4	4	4	4	1	1
8 Millet	33	7a	3	3	1	1	1	4	4	1	1
9 Forestburg	44	6	2	1	1	1	1	4	4	1	1
10 Bashaw	62	6	2	7	7	4	4	4	4	1	1
11 Daysland	42	6	2	7	7	4	4	4	4	1	1
12 Ma-Me-O Beach	13		4	13	13	13	5	1	1	1	1
13 Mulhurst	13		4	13	13	13	5	1	1	1	1
16 Hobbema	16	7b	3	5	5	5	5	1	1	1	1
15 Winfield	15	7b	3	5	5	5	5	1	1	1	1
17 Alder Flat	11		4	5	5	5	5	1	1	1	1
14 Buck Lake	13		4	5	5	5	5	1	1	1	1
18 Heisler	7		3	5	5	5	5	1	1	1	1
19 Hay Lakes	8		3	5	5	5	5	1	1	1	1
20 Lougheed	14		3	5	5	5	5	1	1	1	1
21 Galahad	11		3	5	5	5	5	1	1	1	1
22 Bawlf	8		3	5	5	5	5	1	1	1	1
23 Ferintosh	8		3	5	5	5	5	1	1	1	1
24 Gwynne	5		4	5	5	5	5	1	1	1	1
25 Strome	9		3	5	5	5	5	1	1	1	1
26 New Norway	10		3	5	5	5	5	1	1	1	1
27 Bluffton	8		4	5	5	5	5	1	1	1	1
28 Rosalind	5		3	5	5	5	5	1	1	1	1
29 Westerose	8		5	5	5	5	5	1	1	1	1
30 Armena	3		4	5	5	5	5	1	1	1	1
31 Round Hill	4		4	5	5	5	5	1	1	1	1
32 Ohaton	4		4	5	5	5	5	1	1	1	1
33 Meeting Creek	3		4	5	5	5	5	1	1	1	1
34 Edberg	4		3	5	5	5	5	1	1	1	1
35 Alliance	6		3	5	5	5	5	1	1	1	1
					*						

* Chosen Solution

(b) Non-Hierarchical Grouping Statistics: Battle River

Grouping Stage	Value	Difference
12	7.3	0.2
11	7.5	1.0
10	8.6	1.2
* 9	9.7	0.5
8	10.2	1.3
7	11.5	1.0
6	12.5	3.2
5	15.7	9.5
4	25.2	23.5
3	48.7	14.8
2	63.5	

(a) Edmonton Regional Planning Area: Groups

Places		Establishments	Hierarchical	Regional Plan	Non-Hierarchical Grades						
					5	6	7	8	9	10	11
1	Edmonton	18,130	1	1	10	10	10	10	10	10	10
2	Sherwood Park	524	3		3	3	3	3	3	3	3
3	St. Albert	411	3		4	4	4	4	4	4	4
4	Ft. Saskatchewan	223	3		6	6	6	6	6	6	6
5	Leduc	279	3		6	6	6	6	6	6	6
6	Spruce Grove	224	3		6	6	6	6	6	6	6
7	Drayton Valley	229	3		6	6	11	11	11	11	11
8	Stony Plain	143	4		1	2	2	12	12	12	12
9	Devon	87	5		1	2	2	2	2	12	12
10	Morinville	86	5		1	2	2	2	2	12	12
11	Nisku	68	5		1	2	2	2	2	2	2
12	Namao	62	5		1	2	2	2	2	9	9
13	Ardrossan	44	7a		1	2	2	2	2	9	9
14	Ellerslie	40	7a		1	1	1	1	8	9	9
15	Mayerthorpe	60	6		1	1	1	1	8	8	8
17	Thorsby	54	6		1	1	1	1	8	8	8
18	Legal	41	6		1	1	1	1	8	8	8
19	Onoway	46	6		1	1	1	1	8	8	8
20	Sangudo	40	6		1	1	1	1	8	8	8
16	Calmar	38	7a		1	1	1	1	8	8	1
21	Gibbons	25	7b		1	1	1	1	1	1	1
22	Breton	24	7b		1	1	1	1	1	1	1
23	Warburg	20	7b		1	1	1	1	1	1	1
24	Waskatenau	18	7b		1	1	1	1	1	1	1
25	Alberta Beach	19	7b		1	1	1	1	1	1	1
26	Bon Accord	20	7b		1	1	1	1	1	1	1
32	Entwistle	17	7b		1	1	1	1	1	1	1
27	Evansburg	34	7b		1	1	1	1	1	1	1
28	Seba Beach	14			1	1	1	1	1	1	5
29	New Serepta	15			1	1	1	1	1	1	5
30	Wabamun	13			1	1	1	1	1	1	5
31	Lodgepole	8			1	1	1	1	1	1	5
32	Beaumont	14			1	1	1	1	1	1	5
34	Cherhill	6			1	1	1	1	1	1	5
35	Tomahawk	7			1	1	1	1	1	1	5
36	Alcondale	3			1	1	1	1	1	1	5
37	Duffield	6			1	1	1	1	1	1	5
38	Green Court	3			1	1	1	1	1	1	5
39	Gunn	3			1	1	1	1	1	1	5
40	Rochfort Beach	3			1	1	1	1	1	1	5
41	Sunnybank	5			1	1	1	1	1	1	5
42	Rollyview	3			1	1	1	1	1	1	5
43	Villeneuve	3			1	1	1	1	1	1	5
44	Darwell	5			1	1	1	1	1	1	5
45	Callahoo	6			1	1	1	1	1	1	5
											*

(b) Non-Hierarchical Grouping Statistics: Edmonton Region

Grouping Stage	Value	Difference
12	38.9	0.3
* 11	39.2	1.0
10	40.2	-0.8
9	39.0	4.7
8	43.7	7.2
7	50.9	17.3
6	68.2	17.0
5	85.2	65.3
4	150.5	120.8
3	271.3	391.0
2	662.3	

* Chosen Solution

(a) Peace River Regional Planning Area: Groups

Place	Establishments	Hierarchical	Regional Plan	Non-Hierarchical Grades					
				6	7	8	9	10	11
1 Grande Prairie	731	2b	7	12	12	12	12	12	12
2 Peace River	269	3	6	9	9	9	9	9	9
3 Manning	79	5	5	1	8	8	10	10	10
4 Grimshaw	74	5	5	1	1	1	10	10	10
11 Grande Cache	106	5	5	6	6	11	11	11	11
5 Beaver Lodge	59	6	5	1	1	1	1	1	1
6 Spirit River	58	6	5	1	1	1	1	1	1
7 Falher	63	6	5	1	1	1	1	1	1
8 Fox Creek	55	5	5	1	1	1	1	1	1
13 High Level	90	5	5	8	8	8	8	8	8
9 High Prairie	118	4	5	6	6	6	6	6	6
10 Fairview	116	4	5	6	6	6	6	6	6
12 Valleyview	134	4	5	8	13	13	13	13	13
14 Rycroft	31	7b	4	2	2	2	2	4	4
15 Sexsmith	32	7b	4	2	2	2	2	4	4
16 Hines Creek	17	7b	4	2	2	2	2	4	4
17 LaCrete	26	7b	3	2	2	2	2	4	4
18 McClennan	27	6(7b)	5	2	2	2	2	2	2
19 Hythe	26	7b	4	2	2	2	2	2	2
20 Wanham	11		3	2	2	2	2	2	2
21 Worsley	12		4	2	2	2	2	2	2
22 Eaglesham	14		4	2	2	2	2	2	2
23 Debolt	14		2	2	2	2	2	2	2
24 Donnelly	14		4	2	2	2	2	2	2
25 Girouxville	15		4	2	2	2	2	2	2
26 Ft. Vermilion	15		5	2	2	2	2	2	2
27 Nampa	15		4	2	2	2	2	2	2
28 Wembley	9		4	2	2	2	2	2	5
29 Keg River	3		4	2	2	2	2	2	5
30 Woking	5		3	2	2	2	2	2	5
31 Bezanson	3		2	2	2	2	2	2	5
32 La Glace	4		3	2	2	2	2	2	5
33 Brownvale	6		3	2	2	2	2	2	5
34 Clairmont	8		3	2	2	2	2	2	5
35 Berwyn	22		4	2	2	2	2	2	2
36 Rainbow	19		4	2	2	2	2	2	2
									*

* Seven grades linked to Christaller's ranking are identified. The seventh grade is the largest place. Many other centres were picked out in the Regional Planning Report but were not distinguished in the source used here (telephone directories).

(b) Non-Hierarchical Grouping Statistics: Peace River

Grouping Stage	Value	Difference
12	15.7	1.0
11	16.7	1.7
10	17.4	1.1
9	18.5	2.2
8	20.7	3.3
7	24.0	4.5
6	28.5	1.9
5	30.4	5.4
4	35.6	26.7
3	62.5	40.8
2	10.3	

* Chosen Solution

(a) Westlock Area: Groups

	Places	Establishments	Hierarchical	Regional Plan	Non-Hierarchical Grades				
					4	5	6	7	8
1	Westlock	226	3a	N/A	2	2	2	2	2
2	Barrhead	179	3b		4	4	4	4	4
3	Slave Lake	146	3b		4	4	4	4	4
4	Athabasca	141	3b		4	4	4	4	4
5	Swan Hills	55	5		11	11	11	11	11
6	Kinuso	19	7b		1	5	5	12	12
7	Clyde	22	7b		1	5	8	8	8
8	Fawcett	10			1	1	5	5	5
9	Joussard	4			1	1	1	1	6
10	Jarvie	4			1	1	1	1	6
11	Canyon Creek	5			1	1	1	1	6
12	Smith	9			1	1	1	1	6
13	Blue Ridge	6			1	1	1	1	1
14	Pickardville	7			1	1	1	1	1
15	Pibroch	5			1	1	1	1	1
16	Ft. Assinboine	12			1	1	1	1	1
17	Rochester	9			1	1	1	1	1
18	Faust	5			1	1	1	1	1
19	Vimy	5			1	1	1	1	1
20	Colinton	4			1	1	1	1	1
21	Edson	280	3a		2	2	2	2	2
22	Hinton	264	3a		2	2	2	2	2
23	Whitecourt	192	3a		2	2	2	2	2
24	Jasper	125	3b		4	4	4	4	4
						*			

(b) Non-Hierarchical Grouping Statistics: Westlock Area

Grouping Stage	Value	Difference
9	12.3	0.1
8	12.4	0.1
7	12.5	0.6
6	13.1	0.5
*5	13.6	0.3
4	13.9	5.4
3	19.3	8.0
2	27.3	

(b) North East (Ft. McMurray - Lloydminster) Area

Place		Establishments	Hierarchical	Regional Plan	Non-Hierarchical Grades 5	6	7	8	9	10	11
1	Ft. McMurray	418	3	N/A	2	2	2	2	2	2	
2	Lloydminster	435	3		2	2	2	2	2	2	
3	St. Paul	206	4		4	4	4	4	4	4	
4	Bonnyville	164	4		4	4	4	4	4	4	
5	Grande Centre	158	4		4	4	4	4	4	4	
6	Vegreville	189	4		4	10	10	10	10	10	
7	Wainwright	162	4		4	10	10	10	10	10	
8	Vermilion	142	4		4	10	10	10	10	10	
9	Lac La Biche	101	5		1	1	8	8	8	8	
10	Redwater	78	5		1	1	8	8	8	8	
11	Provost	90	5		1	1	1	1	1	1	
12	Viking	65	6		1	1	1	3	3	3	
13	Tofield	66	5(6)		1	1	1	3	3	3	
14	Lamont	44	6		6	6	1	3	3	3	
15	Smoky Lake	48	6		6	6	1	3	3	3	
16	Two Hills	52	6		6	6	1	3	3	3	
17	Elk Point	48	6		6	6	1	3	3	3	
20	Vilna	32	7b		6	6	6	6	6	6	
21	Boyle	36	7b		6	6	6	6	6	6	
24	Thorhild	27	7b		6	6	6	6	6	6	
25	Andrew	26	7b		6	6	6	6	6	6	
26	Holden	29	7b		6	6	6	6	6	6	
27	Marwayne	24	7b		6	6	6	6	6	6	
29	Mallaig	15	7b		6	6	6	6	6	6	
30	Willingdon	22	7b		6	6	6	6	6	6	
31	Myrnam	26	7b		6	6	6	6	6	6	
39	Bruderheim	20	7b		5	5	6	6	6	6	
23	Mundare	32	7b		6	6	6	6	6	12	
22	Irma	26	7b		6	6	6	6	6	11	
32	Edgerton	25	7b		6	6	6	6	11	12	
28	Glendon	20	7b		6	6	6	6	1	12	
37	Innisfree	18	7b		5	5	6	6	11	12	
18	Cold Lake	41	7b		6	6	6	6	11	12	
36	Hughenden	21	7b		5	5	6	6	11	12	
19	Mannville	30	7b		6	6	6	6	11	12	
38	Ryley	20	7b		5	5	6	6	11	12	
35	Kitscoty	15	3		5	5	5	5	11	12	
33	Ft. Chipewyan	13			5	5	5	5	11	11	
34	Radway	14			5	5	5	5	11	11	
40	Chipman	8			5	5	5	5	5	5	
41	Clandonald	8			5	5	5	5	5	5	
42	Dewberry	9			5	5	5	5	5	5	
43	Ardmore	7			5	5	5	5	5	5	
44	Ashmont	8			5	5	5	5	5	5	
45	Chauvin	11			5	5	5	5	5	5	
46	Plamondon	12			5	5	5	5	5	5	
47	Blackfoot	3			5	5	5	5	5	5	
48	Lindbergh	3			5	5	5	5	5	5	
49	Beauvalon	3			5	5	5	5	5	5	
50	Bodo	3			5	5	5	5	5	5	
1	Wandering River	6			5	5	5	5	5	5	
2	Minburn	3			5	5	5	5	5	5	
3	Warspite	5			5	5	5	5	5	5	

(b) North East (Ft. McMurray - Lloydminster) Area

Place	Establishments	Hierarchical	Regional Plan	Nòn-Hierarchical Grades 5	6	7	8	9	10	11
4 Grassland	4			5	5	5	5	5	5	
55 Islay	6			5	5	5	5	5	5	
6 Fabyan	3			5	5	5	5	5	5	
7 St. Lina	4			5	5	5	5	5	5	
8 Paradise Valley	5			5	5	5	5	5	5	
9 Czar	8			5	5	5	5	5	5	
60 Lavoy	7			5	5	5	5	5	5	
1 Kinsella	8			5	5	5	5	5	5	
2 Ranfurley	5			5	5	5	5	5	5	
3 Newbrook	6			5	5	5	5	5	5	
4 Hairy Hill	8			5	5	5	5	5	5	
5 St. Michael	5			5	5	5	5	5	5	
66 Amisk	8			5	5	5	5	5	5	
7 Derwent	7			5	5	5	5	5	5	
8 Bruce	7			5	5	5	5	5	5	
9 Spedden	7			5	5	5	5	5	5	
70 Heinsberg	6			5	5	5	5	5	5	
								*		

* Chosen Solution

(b) Non-Hierarchical Grouping Statistics: North East

Grouping Stage	Value	Difference
12	72.3	0.2
11	72.5	0.4
10	72.9	0.4
* 9	73.3	0.9
8	74.2	1.7
7	75.9	1.3
6	77.2	2.6
5	79.2	3.9
4	83.7	10.6
3	94.3	74.0
2	168.3	50.1
1	218.4	50.1

REFERENCES

Barker, D. (1978), "A Conceptual Approach to the Description and Analysis of an Historical Urban System". Regional Studies, Vol. 12, p. 1-10.

Baskin, C. (1966), Translation of W. Christaller, "Central Places in S. Germany". Prentice-Hall.

Berry, B.J.L. (1966), "Market Centres and Retail Distribution", Prentice-Hall.

Davies, W.K.D. (1972), "Data Analysis in Urban Geography". Geography, Vol. 57, p. 196-206.

Davies, W.K.D. and Welling, S. (1977), "The Socio-Economic Differentiation of Alberta Towns in 1971" in B.M. Barr (ed). Research Studies by Western Canadian Geographers: The Edmonton Papers. Tantalus Press, pp. 77-79.

Davies, W.K.D. (1979), Service Centres in Alberta: Report No. 1 Data Sources; No. 2 Functional Connections; No. 3 Economic Base Characteristics; No. 4 Commercial Hierarchy. Unpublished Reports. Planning Branch, Department of Municipal Affairs, Alberta Government, Edmonton.

Isard, W. (1956), "Location and the Space Economy". J. Wiley, N. York.

Losch, A. (1954), "The Economics of Location" (English Edition). New Haven, U.S.A.

Oldman River Regional Planning Report (1970), "Service Centre Study". Oldman River.

Peace River Regional Planning Commission (1971), "Central Place Study" Peace River Regional Planning Commission.

Ward, J.H. (1963), "Hierarchical Grouping to Optimize an Objective Function". Journal of the American Statistical Association, 58, p. 236-244.

Wishart, D. (1976), "CLUSTAN IC: A Suite of Cluster Analysis Procedures". University of London Computing Centre.